



PATENT  
FBR6132P0010US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application Of:	)	A DISTRIBUTED STEREO SYSTEM
LEONARD COLIN ANDREWS	)	
Serial No.: 09/485,657	)	Examiner: Justin Michalski
Filed: March 24, 2000	)	Art Unit: 2644

**APPELLANT'S BRIEF ON APPEAL**

Mail Stop Appeal Briefs - Patent  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

Sir:

This brief is submitted in furtherance of the Notice of Appeal filed concurrently  
herewith.

**REAL PARTY IN INTEREST**

The real party in interest is LeisureTech Electronics Pty. Ltd., the assignee of the  
above-referenced application.

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37 CFR 1.8  
CERTIFICATE OF MAILING

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*Corinne Byk*  
Corinne Byk

**RELATED APPEALS AND INTERFERENCES**

There are no related appeals or interferences.

**STATUS OF CLAIMS**

Claims 1-25 are pending in the application, are rejected and are at issue in this appeal.

Claims 1-25 are set forth in the Claims Appendix.

**STATUS OF AMENDMENTS**

An amendment has been filed subsequent to the last Office action. The amendment addresses a §112 rejection to provide proper antecedent basis for several of the dependent claims and to place the claims in better form for appeal. Upon entry of this amendment, appellant assumes that the §112 rejection will be withdrawn.

**SUMMARY OF CLAIMED SUBJECT MATTER**

The present application includes a single independent claim, claim 1, relating to a distributed stereo audio system 1 including at least two speakers 2 and 3 connected to an amplifier 4. The amplifier 4 is housed in a standard electrical light switching housing in the same room as the speakers. See page 4, lines 20-23. In another room, a source of audio signals 5 may comprise a CD player 6, a tape recorder 7, a VCR 8 and a source selector 9. A power supply 10 in the same room as these audio signal sources 5 provides power to the amplifier 4. See page 4, lines 24-26.

The amplifier 4 is connected to the signal sources 5 and to the power supply 10 by a category 5 four pair twisted cable 11. One of the twisted pairs 12 provides the right audio signal. Another twisted pair 13 provides the left audio signal. A third twisted pair 14 provides power from the power supply 10. The amplifier 4 amplifies the left and right standard line level signals and supplies them to the speakers 2 and 3, respectively. The amplifier 4 is controlled by a potentiometer 15 mounted on its fascia plate 16. See page 4, lines 27-35.

The amplifier 4 can be controlled by a handheld remote controller 17 which transmits infrared signals 18 to a receiver 19 mounted in the fascia plate 16. The fascia plate 16 may include displays indicating status of the amplifier and components of the source. Infrared signals may be transmitted, before or after the modulation, from the amplifier 4 back to the source 5 using the fourth twisted pair 20 in the category 5 cable 11. The infrared signals may be used to control the source directly. See page 5, lines 1-11.

The amplifier 4 is designed around a single chip amplifier and has high input impedance enabling several amplifiers to be mounted in different rooms to amplify signals from the same sources 5 for speaker sets in each of the rooms. In each room the sound broadcast may be from the same source components or from different source components. Further, the amplification level may be different in each room. See page 5, lines 12-19.

**GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

1. Claims 7, 12-16 and 22-25 are rejected as indefinite under 35 U.S.C. 112, second paragraph, for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
2. Claims 1-5, 7, 8, 10 and 16-20 are rejected as obvious over Lonstein et al. (Sound & Video Contractor, “Distributed Sound Systems Come of Age”) (hereinafter “Lonstein”) in view of Lampen (Belden Electronics Division, “Cable and the Cutting Edge”, (hereinafter “Lampen reference”).
3. Claims 6, 9, 11, 13-15 and 21-23 are rejected as obvious over Lonstein and the Lampen reference and further in view of QED AudioProducts, Ltd., “An Introduction to Streamline” (hereinafter “QED AudioProducts”).
4. Claims 12, 24 and 25 are rejected as obvious over Lonstein, the Lampen reference, QED AudioProducts in view of SystemLine (S4.3 Multi-Room System Installation Manual) (hereinafter “SystemLine”).

**ARGUMENT**

**Claims 7, 12-16 and 22-25 Are Not Indefinite.**

As noted above, an amendment was filed subsequent to the most recent Office action. The claims were amended to provide proper antecedent for the elements noted in the action. As such, appellant believes that the rejection will be withdrawn. In the event that it is



not, applicant submits that the rejection is improper as a proper antecedent is included with respect to each element of the rejected claims and the rejection ought be reversed.

**Claims 1-4, 7, 8, 10, 17 and 19.**

Independent claim 1, the only independent claim, specifies a distributed stereo audio system including two or more speakers for the broadcast of stereo audio signals, a source of stereo audio signals, a stereo amplifier to amplify stereo audio signals and drive the speakers and a mains operated electrical power supply to provide power to the amplifier. The amplifier is located in the same room as the speakers and remote from the signal source and power supply. The amplifier is connected to the signal source and power supply by means of a category 5 four pair twisted cable which provides, in respective conductors of the twisted pairs, right channel audio signals from the signal source to the amplifier, left channel audio from the signal source to the amplifier and DC power from the power supply to the amplifier.

None of the references, alone or in any proper combination, disclose use of category 5 four pair twisted cable, or any similar cable, which carries audio signals to a stereo amplifier and DC power from a power supply to the stereo amplifier.

Lonstein discloses a distributed audio system including two or more speakers and a source of audio signals and an amplifier to amplify audio signals. A power supply provides power to the amplifier. The amplifier is located on the speaker and can be remote from the signal source and power supply. The amplifier is connected to the signal source and power supply by a

3 wire or 4 wire bus. One wire carries signal, another ground and another 24 volt DC power. An optional fourth wire can be used for stereo systems.

Lonstein does not disclose or suggest use of a category 5 four pair twisted cable, as admitted in the action.

The Lampen reference is not prior art to the present application. The Lampen reference is a technical paper bearing a copyright date of 2001. This is subsequent to the filing date of the above-referenced application. The front page of the reference states that it was originally presented to the Society of Motion Picture and Television Engineers Convention, Sydney, Australia, on Tuesday, July 1, 1997. It is not apparent from this if the technical paper was published or distributed at that time or exactly what occurred at that time. Therefore, applicant submits that reliance on this reference is improper.

In any event, the reference does not teach what is suggested in the Office action. The Lampen reference discusses various grades of unshielded twisted pairs (UTP) cable including categories 1 through 5 and enhanced category 5. The reference also discusses additional cables alleged to be superior to standard or enhanced category 5.

The action states that:

Lampen discloses a Category 5 cable allowing the four-pairs to be used for different, even unrelated signals including analog audio. Lampen further discloses the Category 5 cable provides an improved impedance tolerance and improved attenuation (Paragraphs 3 through 5 under "Shared Sheath and New Technology").

This is incorrect. The Lampen reference is discussing a cable, having a part number 1872A, which “was so superior that it could do a number of things which were not possible with standard or enhanced Category 5.” Thus, the alleged improvements are not related to a category 5 cable, but a particular Belden cable.

Moreover, appellant submits that the combination is improper.

Exhibit 1 hereto is a catalog entitled “Sound Systems by Infinite Modular Power”. This catalog is for the system described in Lonstein, as is apparent viewing the schematic on page 3. Pages 4 and 5 of the catalog more specifically reference that the system is installed with 18 gauge 3 or 4 conductor cable.

Category 5 cable typically uses 24 gauge wire. As is readily known, 24 gauge wire is smaller in size than 18 gauge wire. In fact, as discussed with the Examiner, 24 gauge wire is approximately half the outer diameter of 18 gauge wire and has a resistance more than 4 times that of 18 gauge wire. The fact that an 18 gauge wire in a multi-conductor cable for a distributed audio system such as in Lonstein can carry power to an amplifier, does not support the conclusion that a category 5 cable having 24 gauge wire can be substituted therefor and operate properly.

Exhibit 2 is a technical paper entitled “Non-Data Applications for Category 5 Cable”. It is authored by Steve Lampen of Belden CDT Electronics Division (hereinafter “Lampen article”). The Lampen article indicates that it was presented on September 28, 1999. The Lampen article is apparently authored by the same author as the Lampen reference and is pertinent to the state of the art at least in 1999. Belden is a well-known cable manufacturer. The

subject matter of the Lampen article is similar to that of the Lampen reference. The Lampen article discusses various cables and references that the part number discussed in the Lampen reference (#1872A) is in fact a Category 6 cable.

The Lampen article is particularly directed to applications for Category 5 cable. The Lampen article, at the bottom of page 9, under the heading “Shared Sheath Requirements”, describes applications for Category 5 cable, including use of the cable for audio. It also indicates that Category 5 cable uses 24 gauge wire. The Lampen article beginning at the bottom of page 10 under the heading “Where Shared Sheath Failed”, states the following:

Shared-sheath applications fail where UTP itself fails. The limitations are based on the resistance of 24 AWG pairs. This is obviously why these cable cannot be used for power conductors or speaker cables. These and other similar applications require low resistance.

As such, appellant submits that the position of Steve Lampen and Belden, as of 1999, was that Category 5 cable can be used for audio signals, but category 5 cable cannot be used for power conductors. As such, the Lampen reference and Lampen article together teach away from the combination proposed by the Examiner.

In a telephone interview with the Examiner discussing the Lampen article, and as memorialized in an interview summary from a May 27, 2005 interview, the Examiner disagreed with appellant’s interpretation of the Lampen article noting that category 5 cables are known to conduct power. Initially, there is no reference cited to support this statement. Even if category 5 cables are known to conduct power, it does not support that a category 5 cable can be used to carry audio signals for right and left channels and DC power from a power supply to a stereo

amplifier adapted to amplify stereo audio signals and drive speakers. The Examiner is ignoring the express statements made by a leading cable manufacturer.

Prior to the latest Office action, the claims were rejected based on a Lloyd article. The Lloyd article was directed to a distributed stereo audio system using a category 5 like cable. The cable in the Lloyd article did not carry power.

The Lloyd article describes a KNEKT home entertainment system in which receivers are situated in each room and plug into a standard hi-fi system. As stated in the article, the system is designed to “. . . avoid laying bulky speaker cables throughout a house and pumping high-voltage currents across them from a centralized hi-fi system. Instead we send unamplified signals across the home on “balanced” cables, which avoids picking up interference from other household devices along the way.”

Appellant previously filed a KNEKT system installation manual. (Exhibit 3.) This installation manual describes the KNEKT system in the cited Lloyd article. Appellant refers to the paragraph in bold lettering at the bottom of page 6 of the installation manual which reads as follows:

**Plan the wire route to AVOID (emphasis in original) running beside Mains/Power cables, appliances with motors, Dimmer switches, TV sets or anything that can produce Radio noise. We've seen Fans, Refrigerators and Dimmer switches totally confuse the system and degrade the sound!, so AVOID!!!!**

Page 14, under the heading “Bypassing wall sockets.” includes a statement that “Mains should be supplied via normal sockets in the cupboard and a normal power cord to the products.” Moreover, at page 24, under the heading “ROOM INSTALLATION.”, the

instructions indicate that the audio input should be connected to the RJ45 sockets. It otherwise indicates that the user should “Wire up mains, (power amplifier if using the KNEKT line receiver) and speakers.”

As is apparent from the installation manual for the KNEKT system, the KNEKT system not only does not teach delivering power on the same cable as the audio signals, the user is instructed to AVOID running the power in proximity to the audio signals.

The question is whether or not the prior art as a whole suggests the claimed invention. Even though the Lloyd article is no longer cited, the KNEKT system is in the prior art. The KNEKT system which uses a category 5 type cable for a distributed audio system teaches away from the claimed invention. Moreover, the well-known cable manufacturer Belden discuss use of a Category 5 cable for various applications, including audio signals, and likewise teaches away from using the Category 5 cable for carrying power.

Considering the evidence as a whole, appellant submits that the combination is improper and the invention of claim 1 is not obvious.

Appellant’s undersigned attorney and Andrew Goldfinch, the proprietor of the Assignee, LeisureTech Electronics Pty. Ltd., attended an interview with SPE Isen and Examiner Michalski in November 2004. Appellant presented background information on LeisureTech’s A-Bus System. Particularly, Mr. Goldfinch described how the A-Bus System has achieved commercial success notwithstanding customer reluctance for such a system. Appellant was requested to make this evidence of record. On December 3, 2004, appellant filed a Declaration of Andrew Goldfinch (Exhibit 4) and another Declaration of Jason Knott (Exhibit 5). These

Declarations, both individually and collectively, provided a strong showing of commercial success. This commercial success is attributable to the merits of the claimed invention which is generally a distributed stereo audio signal using a category 5 four-pair twisted cable. This showing is objective evidence that the claims are not obvious.

It is well accepted that objective evidence of non-obviousness must be considered. See Richardson-Vicks v. Upjohn Co., 44 USPQ2d, 1181 (Fed. Cir. 1997). The May 23, 2005, Office action does not even address this objective evidence of non-obviousness. The action states that the applicant's arguments are moot in view of a new ground of rejection. The existence of a new ground of rejection does not render the objective evidence of non-obviousness as moot. The evidence has nothing to do with the cited prior art. The objective evidence has to do with the commercial success of the claimed invention. This evidence must be taken into consideration. It has not been.

In addition to the claims being non-obvious over the cited references, the addition of the commercial success of the invention further supports the non-obviousness of the invention.

For these reasons, claims 1-4, 7, 8, 10, 17 and 19 are not obvious.

**Claims 5 and 20.**

Claim 5 depends from claims 1, 2 or 3 and specifies that the amplifier is based on an integrated circuit amplifier. Claim 20 depends from claim 4 and specifies that the amplifier is based on an integrated circuit amplifier. Lonstein states that it uses an amplifier. However, there

is no detailed disclosure regarding the substance of the amplifier. The action does not point to any aspect of Lonstein for such a teaching. Claims 5 and 20 are allowable for this reason as well.

**Claim 16.**

Claim 16 depends from claim 1 and specifies that the amplifier accepts standard line level signals from the source of stereo audio signals. In Lonstein the cable is driven with a signal that is derived from an ordinary power amplification device that is intended to have enough voltage swing to drive an ordinary loud speaker to a reasonable level. Lonstein uses a current amplification system to overcome resistive losses by supplying power on the cable. The Lonstein amplifier does not accept standard line level signals from the source of stereo audio signals. Claim 16 is believed allowable for this reason as well.

**Claim 18.**

Claim 18 depends from claim 1 and specifies that the amplifier includes a switchable muting system. There is no disclosure or suggestion in Lonstein of such a switchable muting system. The fact that an amplifier can be placed on a speaker does not support that a switchable muting system can be included with the amplifier. Claim 18 is believed allowable for this reason as well.

Thus, for the above reasons, appellant submits that claims 1-5, 7, 8, 10 and 16-20 are not obvious and the rejection ought be reversed.



**Claims 6, 9, 11, 13-15 and 21-23 Are Not Obvious.**

Claims 6, 9, 11, 13-15 and 21-23 depend directly or indirectly from claim 1, discussed above. The deficiencies with respect to Lonstein and the Lampen reference are noted above. The QED Audio Products reference does not disclose or suggest the deficiencies.

The QED Audio Products reference discloses that a room control amplifier in a stereo system can be surface mounted or flush mounted in a room. A remote control handset can be used for remote control of the remote control amplifier.

**Claim 6.**

Claim 6 depends from claim 5 and specifies that the amplifier is constructed to fit into a standard electrical light switch housing. The QED Audio Products article states that the amplifier can be surface mounted or flush mounted. There is no disclosure or suggestion that it is constructed to fit into a standard electrical light switch housing. Moreover, the amplifier in Lonstein is mounted directly to the speaker in place of a transformer. Further current drops could result from mounting the amplifier remotely, as in QED Audio Products. Therefore, the combination does not result in the claimed invention and there is no support for the combination. Claim 6 is believed allowable for this reason as well.

**Claims 9 and 11.**

Claim 9 depends from claims 1, 2 or 3 and specifies that a hand held remote control is provided to transmit infrared signals to a receiver mounted with the amplifier. Claim

11 depends from claim 9 and specifies that the amplifier is mounted inside a standard electrical light fitting having a facie plate that includes an infrared receiver.

As the amplifier in Lonstein is mounted on the rear of the speaker, it is not apparent where an infrared receiver would be mounted or how it would operate. The rejection is improper for this reason as well.

**Claim 13.**

Claim 13 depends from claim 9 and specifies that infrared signals received by the amplifier are transmitted to the source of stereo audio signals through a fourth twisted pair in the category 5 cable.

Lonstein does not include any conductor that could be used to transmit signals to a source of the audio signals. Nor does Lonstein disclose the transmission of any signals from the amplifier to the source of stereo audio signals. Lonstein does not disclose the capability of making use of any such signals. Lonstein is merely directed to distribution of sound, not control. The other references do not provide these deficiencies. Claim 13 is believed allowable for this reason as well.

**Claim 14.**

Claim depends from claim 13 and specifies that infrared signals are modulated before transmission to an infrared emitter which directly controls the source of stereo audio signals.

None of the references disclose modulating an infrared signal. Therefore, claim 14 is believed allowable for this reason as well.

**Claim 15.**

Claim 15 depends from claim 13 and specifies that infrared signals are demodulated and provided as data signals to the source of stereo audio signals.

None of the references discloses the modulating infrared signals and providing them as data signals to a source of stereo audio signals. Therefore, no combination of the references results in the invention. Claim 15 is believed allowable for this reason as well.

**Claim 21.**

Claim 21 depends from claim 20 and specifies that the amplifier is constructed to fit into a standard electrical light switch housing. Claim 20 specifies that the amplifier is based on an integrated circuit amplifier. As discussed, Lonstein does not disclose the particular design of its amplifier. The QED Audio Products article does not disclose that the amplifier is constructed to fit into a standard electrical light switch housing. Claim 21 is believed allowable for this reason as well.

**Claim 22.**

Claim 22 depends from claim 11, discussed above, and specifies that infrared signals are modulated before transmission to an infrared emitter which directly controls the

source of stereo audio signals. In addition to the arguments discussed above relative to claim 11, none of the references disclose modulating infrared signals before transmission to an infrared emitter. Claim 22 is believed allowable for this reason as well.

**Claim 23.**

Claim 23 depends from claim 22 and specifies that the amplifier accepts standard line level signals from the source of stereo audio signals. The deficiencies of the references with respect to claim 22 are discussed above. Additionally, Lonstein does not disclose that the amplifier accepts standard line level signals, as noted above.

Claim 23 is believed allowable for these reasons as well.

For the above reasons, claims 6, 9, 11, 13-15 and 21-23 are believed allowable and reversal of the rejection is requested.

**Claims 12, 24 and 25 Are Not Obvious.**

Claims 12, 24 and 25 depend indirectly from claim 11. The deficiencies with respect to Lonstein, the Lampen reference and the QED Audio Products as applied to claim 11 are noted above.

**Claim 12.**

Claim 12 depends from claim 11 and specifies that the fascia plate includes status indicators for the amplifier and source of stereo audio signals. SystemLine is cited for disclosing

a display of selected source and status indications. It is not apparent how this reference could be combined with the basic reference, Lonstein, to provide a functional system. Lonstein discloses use of a 3 or 4 wire bus. It does not disclose or suggest any type of data signals for transmission within the system. Thus, Lonstein does not disclose any means for providing status information at the speaker. Therefore, the combined system would be inoperative. The combination is improper. Claim 12 is believed allowable for this reason as well.

**Claim 24.**

Claim 24 depends from claim 12 and specifies that infrared signals are modulated before transmission to an infrared emitter. None of the references disclose modulating infrared signals before transmission to an infrared emitter. Again, it is not apparent how the status information, infrared signals, audio signals and power could be transmitted on the three wire bus of Lonstein or that Lonstein could make use of any of these signals.

Claim 24 is believed allowable for these reasons as well.

**Claim 25.**

Claim 25 depends from claim 24 and specifies that the amplifier accepts standard line level signals from the source of stereo audio signals. The deficiencies with respect to claim 24 are noted above. Lonstein does not disclose or suggest the amplifier accepting standard line level signals. Claim 25 is believed allowable for this reason as well.

For the above reasons, claims 12, 24 and 25 are not obvious and reversal of the rejection is requested.

**CLAIMS APPENDIX**

1. A distributed stereo audio system, including: two or more speakers for the broadcast of stereo audio signals, a source of stereo audio signals, a stereo amplifier to amplify stereo audio signals and drive the speakers, and a mains operated electrical power supply to provide power to the amplifier; where the amplifier is located in the same room as the speakers, and remote from the signal source and power supply; and where the amplifier is connected to the signal source and power supply by means of a category 5 four pair twisted cable which provides, in respective conductors of the twisted pairs, right channel audio signals from the signal source to the amplifier, left channel audio from the signal source to the amplifier and DC power from the power supply to the amplifier.

2. A distributed stereo audio system according to claim 1, wherein amplifier and speaker sets in several rooms receive signals from a single source of audio signals.

3. A distributed stereo audio system according to claim 1, wherein the source provides a selection of components, selected from any one of a tape recorder, VCR, radio or CD, and different audio signals are provided to different rooms.

4. A distributed stereo audio system according to claim 1, 2 or 3, wherein the volume is set differently in each room.

5. A distributed stereo audio system according to claim 1, 2, or 3, wherein the amplifier is based on an integrated circuit amplifier.
6. A distributed stereo audio system according to claim 5, wherein the amplifier is constructed to fit into a standard electrical light switch housing.
7. A distributed stereo audio system according to claim 1, 2 or 3, wherein the amplifier output level is controlled by the output level of the source of stereo audio signals.
8. A distributed stereo audio system according to claim 1, 2 or 3, wherein a manual volume control is included with the amplifier.
9. A distributed stereo audio system according to claim 1, 2 or 3, wherein a hand-held remote control is provided to transmit infrared signals to a receiver mounted with the amplifier.
10. A distributed stereo audio system according to claim 9, wherein the amplifier is mounted with a speaker.



11. A distributed stereo audio system according to claim 9, wherein the amplifier is mounted inside a standard electrical light fitting having a fascia plate that includes an infrared receiver.

12. A distributed stereo audio system according to claim 11, wherein the fascia plate also includes status indicators for the amplifier and the source of stereo audio signals.

13. A distributed stereo audio system according to claim 9, wherein infrared signals received by the amplifier are transmitted to the source of stereo audio signals through a fourth twisted pair in the category 5 cable.

14. A distributed stereo audio system according to claim 13, wherein the infrared signals are modulated before transmission to an infrared emitter which directly controls the source of stereo audio signals.

15. A distributed stereo audio system according to claim 13, wherein the infrared signals are demodulated and provided as data signals to the source of stereo audio signals.

16. A distributed stereo audio system according to claim 1, wherein the amplifier accepts standard line level signals from the source of stereo audio signals.

17. A distributed stereo audio system according to claim 1, wherein the amplifier accepts speaker signals from another amplifier.

18. A distributed stereo audio system according to claim 1, wherein the amplifier includes a switchable muting system.

19. A distributed stereo audio system according to claim 1, wherein the amplifier includes an adjustable input level trim device.

20. A distributed stereo audio system according to claim 4, wherein the amplifier is based on an integrated circuit amplifier.

21. A distributed stereo audio system according to claim 20, wherein the amplifier is constructed to fit into a standard electrical light switch housing.

22. A distributed stereo audio system according to claim 11, wherein the infrared signals are modulated before transmission to an infrared emitter which directly controls the source of stereo audio signals.

23. A distributed stereo audio system according to claim 22, wherein the amplifier accepts standard line level signals from the source of stereo audio signals.

24. A distributed stereo audio system according to claim 12, wherein the infrared signals are modulated before transmission to an infrared emitter which directly controls the source of stereo audio signals.

25. A distributed stereo audio system according to claim 24, wherein the amplifier accepts standard line level signals from the source of stereo audio signals.

**EVIDENCE APPENDIX**

Attached hereto are 5 exhibits comprising evidence entered or referred to by the Examiner and relied on by the appellant in the appeal.

Exhibit 1 is the first 5 pages of a catalog entitled "Sound Systems by Infinite Modular Power". This exhibit was attached by the Examiner to the Interview Summary for the telephonic interview conducted on May 23, 2005, and referenced in an office communication mailed June 3, 2005.

Exhibit 2 is a technical paper entitled Non-Data Application for Category 5 Cable. This exhibit was attached by the Examiner to the Interview Summary for the telephonic interview conducted May 27, 2005 and referenced in the office communication mailed June 3, 2005.

Exhibit 3 is the Knekt system installation manual. This manual is relied on in an Office action mailed September 28, 2004.

Exhibit 4 is the Declaration under 37 CFR 1.132 of Andrew Goldfinch.

Exhibit 5 is the Declaration under 37 CFR 1.132 of Jason Knott. These Declarations were filed with an Amendment on December 3, 2004. The Office action of May 23, 2005, indicates that it is responsive to the communication filed on December 3, 2004. Also, these Declarations are shown on the PAIR system.

**RELATED PROCEEDINGS APPENDIX**

There are no related proceedings.


**SUMMARY**

Summarizing, no proper combination of the cited references results in the claimed invention. Moreover, the combination is improper. For this reason, each of the claims 1-25 is believed allowable and reversal of the rejection is requested.

Respectfully submitted,

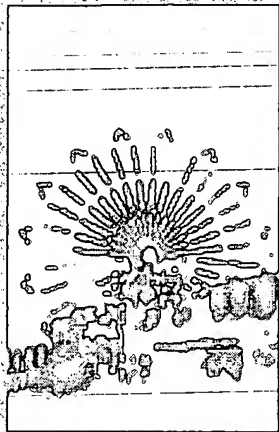
Dated: July 5, 2005

By:

  
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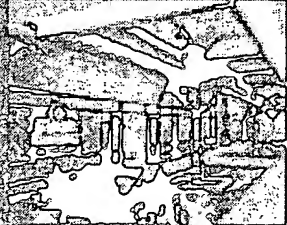
# Sound Systems by Infinite Modular Power



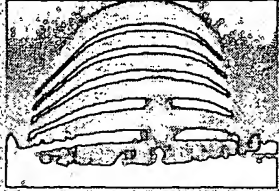
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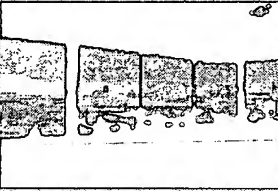
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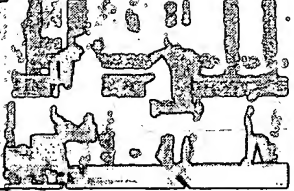
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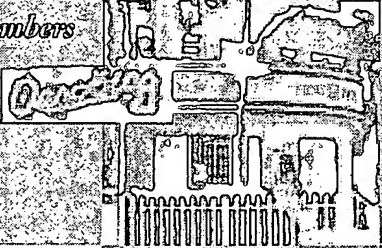
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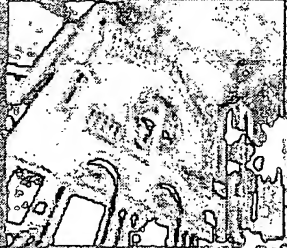
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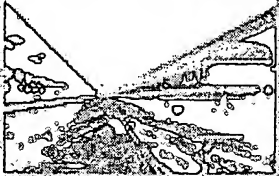
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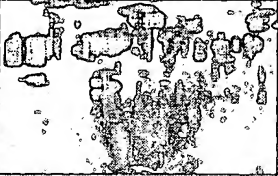
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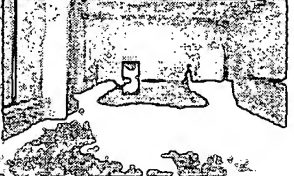
*Houses of Worship*



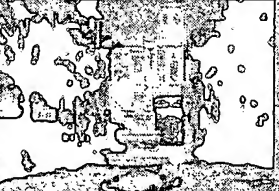
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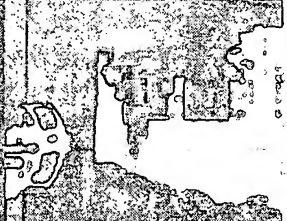
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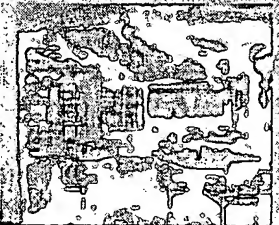
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*Home & Gardens*



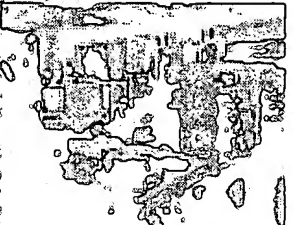
*Doctors Offices*



*Restaurants*



*Museums*



*Retail Stores*

# THE NEXT LEVEL IN THE EVOLUTION

Once in a while something enters the market and changes the rules.

The outdated transformer is removed from the system achieving higher quality sound, easier design, and faster installation than ever before.

With Infinite Modular Power Systems highs soar effortlessly above the deep bass as music and voice is reproduced with unprecedented clarity.

## Advancing the art of sound system design

10 years of R&D and field testing have produced Infinite Modular Power.

### Time Saving Solutions

Leading edge products that work with Plug and Play simplicity.

### Technology Solutions

Line level signal through out the system means that line level devices can be added anywhere in the system.

### Operation and Reliability Solutions

Our electronics set the standard for reliability and functionality with an unmatched 7 year warranty

### Market Solutions

Name your niche. Small or a large, simple or complex  
If you are using more than two speakers, IMP has the solution for you

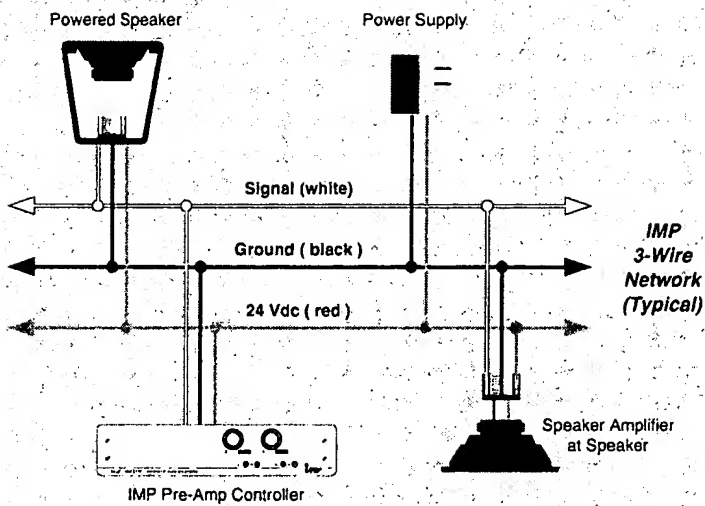
### Sound Quality Solution

Full frequency response of 20 Hz to 20KHz gives all the highs and lows the human ear can hear.

### Delivering digital quality sound reproduction



# OF SOUND SYSTEMS



- so advanced it's simple

IMP is a complete system with

1. Better sound with improved fidelity, dynamic range and high articulation.
2. Modular "plug and play" Network that reduces system complexity and maximizes creative flexibility.
3. Savings in labor installation costs
4. Space saving. No Amplifier racks.
5. Rugged reliability and serviceability
6. User-friendly control results in savings on training and call backs
7. Easy Interconnection. Simple upgrades and expansion
8. Safe low 24 VDC power
9. 7 year warranty on our electronics.
10. Infinite control options

One vendor for complete system



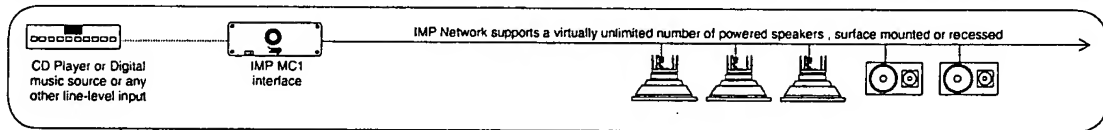
# The Practical Science of Infinite Modular Power

## Multiple Input, Multiple Zone, Multiple Speaker System

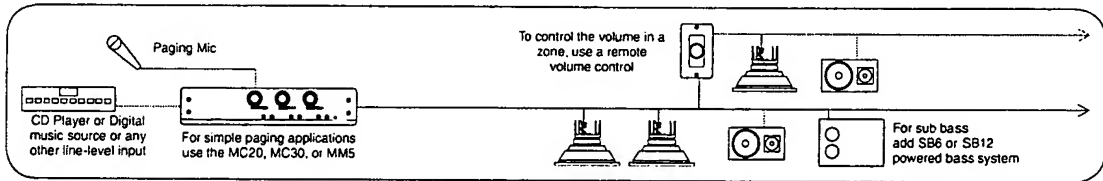
Infinite Modular Power was conceived as a dynamic set of components that expand the benefits of distributed amplification eliminating traditional drawbacks or limitations. Exceptional quality, absolute reliability, and infinite flexibility are the design criteria. In concept, IMP is a 3-wire line level bus onto which the safe 24 volt DC current is applied separately from the audio signal, throughout the system. Power and signal can be drawn at any given point on the bus, where required. This provides a high audio level (SPL) through the system, while low source impedance and high load impedance make the audio signal transparent precluding the probability of radio frequency, electromagnetic or electrostatic interference. This also makes shielded cable unnecessary. With no large signal line currents, the IMP System has negligible line loss. In an IMP system power is applied where it is needed, at each loudspeaker.

The system is color coded and modular for easy installation and maintenance. Installed with 18 gage 3 conductor cable for mono (4 conductor for stereo). Using Daisy chain or home run method, our speaker wiring harnesses and quick connect plugs make this a clean and efficient system that installs quickly.

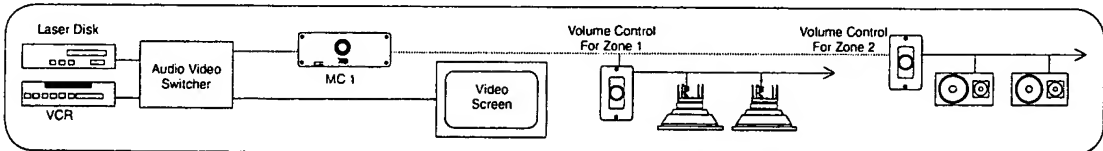
Basic Music System for Restaurant, Bar, Retail Store Doctors Office etc.



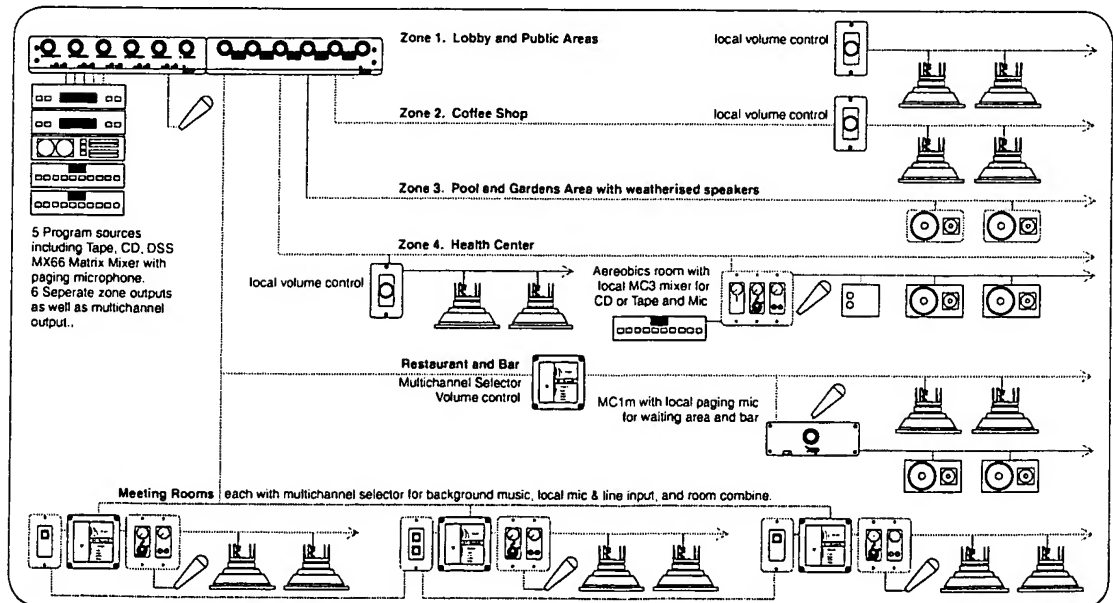
Typical Store Background Music and Paging System



Typical Multimedia System



Overview of a Typical Multiple Function Hotel System



# How to Build A System

## 1. Select the Speakers.

- ☐ Ceiling mounted (page 12)
- ☐ IMP Self-powered (page 10)
- ☐ Other makes of speakers

No limit to the number of speakers and speaker amplifiers in IMP Systems.

Decide how loud the system will be.

Does your system require low level for background applications?

Or moderate level for articulate microphone based systems.

Or a Rock and Roll foreground Music system?

Or anywhere in between

## Select the Speaker Amplifiers

- ☐ 5, 10, 20, 40, or 75 watt

Power where you need it, at the speaker. Achieve increased damping and control over the speaker cone for exceptional performance and overcome line losses, phase distortion, signal degradation and restricted frequency response present in traditional systems. Choose the speaker amplifiers for your system on Page 6.

## 2. Select the Mixers

- ☐ IMP Mixers. Features for any system. (page 8)
- ☐ Another brand of mixer (plus IMP System Interface)

## Add Ancillary Control Devices

- ☐ Volume Controls
- ☐ Local Equalizer
- ☐ Ambient noise volume control
- ☐ Line Monitor
- ☐ Remote program selectors
- ☐ Room combiner

Use any of these components individually or in any combination that you choose.

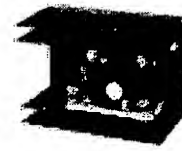
## 3. Choose the Power supply.

- ☐ 2, 4, 12, 18, 27, and 35 Amp. (page 7)
- Selecting the correct power supply or supplies for each system is made easy by IMP's Power Unit rating system. All the details are on Page 7.

## The IMP speaker line is our network.

A free flowing plug and play network created by the modular nature of the distributed amplification. It intelligently links IMP line-level devices anywhere, effectively removing the boundaries present in traditional systems. Multiple IMP devices can be used in combination in a system without complicated wiring, and different power ratings of speaker amplifiers operate flawlessly in the same system. Cascade, link and combine mixers for multiple tasks; join rooms with a switch; select multiple programs remotely, and, zone your system to suit your needs. Install the power supply anywhere in the system. The IMP Network is unique because it is infinitely expandable and highly flexible.

1



*Speaker amplifier with plug in harness.*



*Installs  
on the speaker  
inside a cabinet  
in weatherproof box for outdoor or wet locations*

2



*Signal input is controlled by a preamplifier/mixer.  
Local control is provided by ancillaries such as :  
Volume controls  
Auto level controllers  
Local equalizers  
Multi channel selectors*

3



*Power supply provides the power*

*Connect everything together with  
standard 18 gage 3 conductor cable*

*IMP's  
Infinite  
Network*

*Create the system your customer wants, at a price  
that he likes, with the simple operation that he will  
appreciate, and save time and money*

## Things you will not need :

- ☐ Transformers
- ☐ Racks and rack space
- ☐ Labor intensive wiring
- ☐ Bulky amplifiers

## Technical Papers

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### Non-Data Applications for Category 5 Cable

Most of this paper was originally presented as "Multimedia with MediaTwist" at Belden  
"Tech Day",  
September 28, 1999

Steve Lampen  
Technology Specialist  
Multimedia Products  
Belden CDT Electronics Division

#### What is Multimedia?

For UTP cable products, "multimedia" is the ability of a cable to support data and non-data applications. Data applications might include 10baseT or 100baseT networking, emerging Gigabit systems, such as Gigabit Ethernet™ or Wideband™.

Non-data applications encompass a wide variety of signal types such as analog audio, in both consumer and professional applications or Video, both analog and digital, and running in applications as diverse as surveillance, factory automation, and professional SDI digital video.

Almost anything done by twisted pairs or coax cables, with bandwidth below approximately 500 MHz is possible. This would therefore include applications such as machine control (RS-422, or RS-485), or even the bandwidth "king" broadband/CATV

#### Networking Options

All of these signal types listed above could easily be configured within a network architecture. There are many software packages that allow you to ship audio and video; for instance, as a part of the network data stream. Videoconferencing to the desktop is most often distributed in this fashion. A small video picture of low quality covers a small portion of the user screen. The bandwidth used for the distribution is directly related to the frame rate, the detail, and the size of the image. Often a picture can be displayed for a bandwidth "cost" of only a few kilobits.

Since these network applications are software-driven, cable choice only applies to the network as a whole. And, while we do not intend to discuss these software applications, it should be noted that any application that requires added bandwidth should obviously employ the cable with the widest bandwidth and which provides the greatest possible distance.

#### What is Shared Sheath?

It's one thing to carry an exotic non-data signal on a UTP cable. But what about using all four pairs of a UTP to handle multiple different signals?

The ability to support more than one signal type on a single 4-pair is termed "shared sheath". It should be mentioned at the outset that shared-sheath applications are mentioned in TIA/EIA 568A but only in regards to multiple data signals on multipair cable, such as

25-pair Category 5. No mention is made of combining non-data applications.

What can be combined in shared sheath? The answer to this question lies squarely in the performance of a UTP cable. Each non-data application has "critical" factors. In multichannel audio, for instance, crosstalk and capacitance are the critical issues. It is then the most critical parameter of the most critical signal that rules over all. This parameter will set things like the "maximum distance" the cable can run.

Some of the shared sheath combinations might include data + data, such as two 10baseT or two 100baseT circuits, data + audio, data + video, multiple audio channels, multiple video channels, audio + video, data + machine control. With each of these combinations, an analysis of the various signals must be made and the requirements of each ascertained.

### What Cables?

We are specifically talking about UTP Category cables, including Category 5, and "Enhanced" Category cables, such as Category 5E, and Category "6". There is also data available in the Anixter "Levels" program that may apply to non-data applications. This would include Anixter Level 6 and Level 7 cables. However, in the interest of simplicity, we will concentrate on Category 5 (Belden 7811A), 5e (Belden 1583A and 1700A), and 6 (Belden 1872A).

Plenum versions of the last three cables are also available. Performance of plenum versions, and suitability for non-data applications, is the same as the non-plenum versions mentioned in this paper.

It should be noted that, as of this writing, Category 6 specifications are still not ratified. It is therefore more appropriate to use the performance figures of the actual cable than the standards as outlined in TIA/EIA-568-A and similar documents. Where standards do exist they may be appropriate to judge the performance of "generic" cable for data and non-data applications, but the actual measured performance of a cable will always give more accurate comparisons.

All cables are compared at a distance of 100 meters (328 ft.) Studies done in 1982 by AT&T indicate that this distance covers 99.9% of all network office installations. It is not too hard to imagine, therefore, that the same distance would be appropriate for most non-data installations. One exception to this might be factory automation and control.

### Unbalanced Analog Audio Requirements

Unbalanced audio is the "standard" for consumer audio interconnection. Since Category products are now commonly used in the wiring of new houses, and home communication upgrades, it is essential that we include it here. However, these cables have no standards, just "common" standards...

Parameter	7811A	Unbalanced analog
Crosstalk	-102 dB @ 20 kHz	-90 dB @ 20 kHz
Impedance	$100\Omega \pm 15\Omega$	No requirements
Capacitance	15 pF/ft	<50 pF/ft.
Gage	24 AWG	No requirements

Format	Balanced	Unbalanced
Distance	100 meters (328 ft.)	20-30 ft. maximum

Since this is an unbalanced standard, in order to employ UTP, or any twisted pairs, a balun must be used. The choice of baluns is covered in a later section.

### Balanced Analog Audio Requirements

Balanced analog audio cables are stranded twisted pairs of 22AWG or 24AWG, with a foil shield and drain wire, and covered with an overall jacket. They are commonly used in professional installations such as radio or television stations, or recording studios.

Parameter	7811A	1583A/1700A	1872A	Balanced Audio
Crosstalk at 20 kHz	-102 dB	-105 dB	Unreadable >110 dB	used to be -60 dB now, it's -90 dB
Noise (S/N) at 20 kHz	-102 dB	-105 dB	Unreadable >110 dB	used to be -60 dB now, it's -90 dB
Impedance	100 $\Omega$ $\pm$ 15 $\Omega$	100 $\Omega$ $\pm$ 12 $\Omega$	100 $\Omega$ $\pm$ 12 $\Omega$	No requirements
Capacitance	15 pF/ft	15 pF/ft	15 pF/ft	30 -- 50 pF/ft.
Gage	24 AWG	24 AWG	24 AWG	22 AWG/24 AWG
Format	Balanced	Balanced	Balanced	Balanced
Conductor	Solid	Solid	Solid	Stranded
Construction	UTP	UTP	UTP	Foil shield

### Another View of UTP and Balanced Lines

One manufacturer, Radio Systems (Dan Braverman, Michael Sirkis), has brought out a series of products called "Studio Hub". These are balanced line analog audio patch panels which use Category 5 as the wiring medium. However, they suggest shielded Category 5 (STP). The decision to use STP rather than UTP was based on the requirement for good common mode noise rejection (CMRR). The following quote is from an email of Mr. Sirkis:

"Radio Systems has no control over what signals will be connected to Studio Hub. This means balanced or unbalanced (although we say StudioHub is a balanced product someone will either hook up an unbalanced piece of equipment or unknowingly create an unbalanced connection), and any signal level from mic to line. We also have no control on what signals may be adjacent to Studio Hub cables.

In addition, most broadcast equipment is designed with active differential inputs that are constructed with 1% resistors. There is no trimming provided for CMRR. Hence, 40 dB CMRR is often the case (or worse if all the resistor values go to the wrong side of the tolerance). Sometimes, station engineers will build circuits with what ever parts are available -- 5% resistors (now its 26 dB CMRR).

While there is some tolerance (from the user) for cross talk between left and right channels (of the same source) there is no tolerance for cross talk between dissimilar signals. Since we can't count on the rejection of common mode



signals, or masking them with level the best thing to do about crosstalk is to minimize it from happening. Hence, shielded cable."

Also, during initial development of StudioHub not a single customer was willing to consider StudioHub with UTP. Without STP there would have been very little (if any) StudioHub sold.

The lessons here are obvious. For any data or non-data application, the performance of the cable is only as good as the boxes to which it is attached. You can ruin excellent cable performance with poor equipment choices.

However, this problem is not insurmountable if one chooses to determine the CMRR figures of equipment before it is purchased. Most modern analog equipment provides excellent performance values.

### **Stop Thinking in a "Shielded World"**

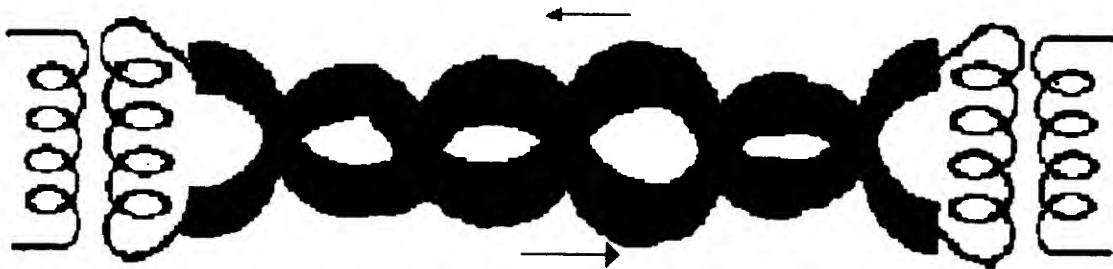
It is fully understood that many engineers, especially those in broadcast, were raised in a "shielded pair" world, and the idea of using UTP requires a philosophical jump. But isn't that why you're reading this paper? You want to be given all the options before you decide how to wire up an installation. UTP is definitely one of those options!

Note: For UTP to be effective in most audio systems, the radiating signal must be extremely low and the CMRR high. This requires the source differential output to be equal and opposite (equal symmetry). In addition, the destination differential amplifier must have excellent CMRR. This is not commonplace in today's environment and therefore careful consideration must be used in designing such a system. The effects of low frequency shielding and coupling can not simply be ignored without the proper considerations.

There are many other benefits to UTP, such as no ground loops (no shield, no drain wire) which would be attractive to designers of non-data systems.

### **What is a Balanced Line?**

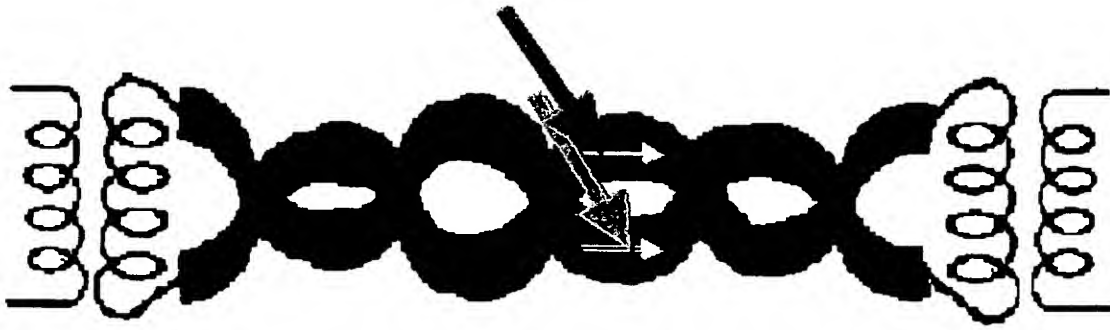
A balanced line is a wiring configuration that uses two wires to transfer the signal from point to point. The key is that the signal is the same on both wires, but opposite polarity (see arrows). Thus, if you add up the signal at any given place along the pair, the sum total should always be zero.



**Signals travel in opposite direction or "differential mode".**

When noise strikes the pair, it induces a voltage in the same ("common mode ") direction. At either end of the cable is a transformer or active balanced circuit (and electronic

equivalent to a transformer). Since this will only pass signals that are of opposite polarity ("differential mode"), the noise, which is the same, cancels out.



### Noise travels in the same direction or "common mode"

The construction of the cable and the "balance" of the system at either end are critical for good noise rejection. In multipair cables, this is also the basis for low crosstalk. Here is a list of factors that will compromise low noise and low crosstalk performance:

1. The conductors are not the same size (AWG) or same resistance. ("Resistance unbalance")
2. The conductors are not the same length. ("Resistance unbalance")
3. The conductors are not in the center of their insulation. ("Capacitance unbalance")
4. The conductors vary in distance between them ("Capacitance unbalance")
5. The different pair twistings are not ideal.
6. Bending the cable forces pairs together ("nesting") which dramatically increases crosstalk.
7. Bending the cable makes pairs separate, changing the impedance of that pair, making them radiate signal energy.

Here's why fixing these problems leads to lower crosstalk and lower noise ingress/egress:

The closer the wires are to each other, the more identical the noise is on both wires and the more completely it cancels out.

There is currently no computer on earth that could cost-effectively determine the most effective twist ratios between four pairs at 100 MHz (much less 350 MHz or 550 MHz).

Dramatically different twist ratios can give you excellent crosstalk numbers. But the length of the wires is also radically different, affecting skew/delay, the timing of the four pairs. Skew/delay is critical in systems that use all four pairs simultaneously such as Gigabit network protocols or RGBS video transmission.

Separating the pairs physically dramatically improves crosstalk. But the construction must keep the pairs separated, especially when the cable is flexed or bent.

### Digital Audio Requirements

Digital audio is a sampled version of analog audio. Desired quality is achieved by choosing different sampling rates. The higher the sampling rate, the better the copy will be at the end of the process. Here are the sampling rates and bandwidths:

Sampling Rate	Multiply by...	Bandwidth	Application
32 kHz	128	4.096 MHz	Voice/News
38 kHz	128	4.864 MHz	DAT
44.1 kHz	128	5.6448 MHz	Home CD
48 kHz	128	6.144 MHz	Audio w/Video
96 kHz	128	12.288 MHz	Recording
192 kHz	128	24.576 MHz	Recording

In any system with multiple bandwidths, "If it works with the highest, it will work with them all." So, we compare AES/EBU digital audio requirements at 25 MHz, the highest bandwidth.

On the next page, we compare digital audio with standard Category 5. This is such a good fit, that many people are surprised. They shouldn't be! Digital audio is really just another type of data stream, a rather generic one at that, built to run down high quality twisted pairs.

Parameter	7811A	AES/EBU Digital Audio
Crosstalk	-41 dB @ 25 MHz	-30 dB @ 25 MHz
Impedance	$100\Omega \pm 15\Omega$	$110\Omega \pm 20\%$ (88-132 $\Omega$ )
Capacitance	15 pF/ft	13 pF/ft.
Gage	24 AWG	22/24 AWG, no spec
Format	Balanced	Balanced
Conductor	Solid	Stranded
Construction	UTP	Shielded

All UTP constructions do well with AES/EBU digital.

Parameter	7811A	1583A/1700A	1872A	AES/EBU Audio
Crosstalk @ 25 MHz	-41 dB	-44.3 dB	-51.3 dB	-30 dB
Impedance	$100\Omega \pm 15\Omega$	$100\Omega \pm 12\Omega$	$100\Omega \pm 12\Omega$	$110\Omega \pm 20\%$
Capacitance	15 pF/ft	15 pF/ft	15 pF/ft	13 pF/ft
Gage	24 AWG	24 AWG	24 AWG	22/24 AWG
Format	Balanced	Balanced	Balanced	Balanced
Conductor	Solid	Solid	Solid	Stranded
Construction	UTP	UTP	UTP	Foil shield

There are three standards for AES/EBU. The first is the balanced line, outlined above. The other two are based on coax cable. There is a professional version (AES-3id) and a consumer version (S/PDIF). They are not identical and not completely compatible. To use twisted pairs in the coax version, a balun would be required to convert from 110 $\Omega$  twisted pairs to 75 $\Omega$  coax.

### Video Requirements

Parameter	7811A	1583A/1700A	1872A	Standard
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	<b>analog video</b>			
<b>Bandwidth</b>	100 MHz	200 MHz	350 MHz	DC to 4.2 MHz
<b>Crosstalk</b>	-53 dB @ 4 MHz	-56 dB @ 4 MHz	-63 dB @ 4 MHz	-60 dB (no spec)
<b>Impedance</b>	$100\Omega \pm 15\Omega$	$100\Omega \pm 12\Omega$	$100\Omega \pm 12\Omega$	$75\Omega \pm 3\Omega$
<b>Capacitance</b>	15 pF/ft	15 pF/ft	15 pF/ft	20 pF/ft.
<b>Gage</b>	24 AWG	24 AWG	24 AWG	Varies with cable size
<b>Format</b>	Balanced	Balanced	Balanced	Unbalanced

Since standard video cable is "unbalanced" coax, it is not directly compatible with any twisted pair or UTP format. To use UTP, we must convert from BALanced to UNbalanced. The device is therefore called a BALUN. (That's "bal-un", not "bay-lun"). Baluns are sometimes called "matching transformers" or "impedance converters."

### Digital Video

Digital video comes in a number of data rates. Here are some of the uncompressed professional video formats:

<b>Data Rate</b>	<b>Bandwidth</b>	<b>Protocol</b>
143 Mbps	71.5 MHz	NTSC composite
177 Mbps	88.5 MHz	PAL composite
270 Mbps	135 MHz	NTSC/PAL component

All of these appear in the standard SMPTE 259M. The most common is the 270-Megabit standard, and therefore all cable and system testing are done to that standard. It should be noted that 135 MHz is beyond the 100 MHz limit for standard Category 5. Therefore, this cable is eliminated from running these signals and Category 5e or 6 cables are then required.

Significant live testing was done with 270/135 at UL Labs. Both bonded-pair Belden products (1700A, 1872A) passed the Class A -- Digital Devices spec for digital coax to the home. These are the first, and so far only, twisted pair cables to have passed this test.

Below are the comparisons between SMPTE 259M SDI (serial digital interface) and Category 5e and Category 6. It is obvious that a balun will be required to match the impedance and to convert from balanced to unbalanced (and back again).

<b>Parameter</b>	<b>7811A</b>	<b>1583A/1700A</b>	<b>1872A</b>	<b>SMPTE 259M</b>
<b>Bandwidth</b>	100 MHz	200 MHz	200 MHz	135 MHz
<b>Crosstalk @ 135 MHz</b>	Unknown	>33 dB	>40 dB	-30 dB
<b>Impedance</b>	$100\Omega \pm 15\Omega$	$100\Omega \pm 12\Omega$	$100\Omega \pm 12\Omega$	$75\Omega \pm 3$
<b>Capacitance</b>	15 pF/ft	15 pF/ft	15 pF/ft	16 pF/ft
<b>Gage</b>	24 AWG	24 AWG	24 AWG	Coax - various
<b>Format</b>	Balanced	Balanced	Balanced	Unbalanced

<b>Conductor</b>	Solid	Solid	Solid	Solid center
<b>Construction</b>	UTP	UTP	UTP	Coax
<b>Distance</b>	Not Useable	328 ft.	450 ft.	>659 ft.

It should be noted that coax cable would go significantly farther than UTP, based on superior impedance tolerance and lower resistance (more copper).

### Machine Control Requirements

Machine control systems are basically low data rate networks for controlling devices. In the broadcast world, they are commonly used to control audio and video tape machines, cart playback devices, or hard disc servers, which mimic tape machines.

Hard-disc servers are becoming the *de facto* standard to replace audio and video tape machines and are the first widely accepted amalgam of data and audio/video technology. So audio, video, and control signals to this equipment could employ the same cable. The table below compares Category 5 to the three common forms of machine control.

Parameter	7811A	RS-232	RS-422	RS-485
<b>Bandwidth</b>	100 MHz	Unspecified	10 MHz	10 MHz
<b>Crosstalk</b>	47 dB @ 10 MHz	Unspecified	Unspecified	Unspecified
<b>Impedance</b>	$100\Omega \pm 15\Omega$	Unspecified	$100\Omega$	$120\Omega$
<b>Capacitance</b>	15 pF/ft	30 pF/ft	12.5 pF/ft	12.5 pF/ft
<b>Gage</b>	24 AWG	Unspecified	24 AWG	24 AWG
<b>Format</b>	Balanced	<i>Unbalanced*</i>	Balanced	Balanced
<b>Construction</b>	UTP	Stranded	Stranded	Stranded

\*We are unaware of any baluns made to convert RS-232 to UTP.

### Broadband/CATV Requirements

The hardest of all non-data applications for UTP is broadband/CATV because of one single factor, bandwidth. Cable TV systems often go up to 1 GHz (158 channels) or more. There are even 500-channel systems currently being offered.

Since Category 5 is only specified to 100 MHz (and even MediaTwist is only spec'd to 550 MHz), these UTP cables offer insufficient parameters to carry the full spectrum of broadband/CATV signals. Does this mean you can't use UTP for broadband/CATV? No. It just means you will be bandwidth (channel) limited.

There are many applications, such as schools, hotels and hospitals, where only a few channels are offered. In those applications, UTP might be a possible choice.

The other limitation to UTP is gage size. Two 24 AWG wires do not come close to a broadband/CATV cable in terms of basic resistance. Therefore, UTP is significantly limited in distance compared to standard coax designs.

And finally, we have cost. Broadband/CATV coax is very cost-effective. Its cost is probably closer to Cat 5 than any other application we have mentioned so far.

Therefore, UTP really offers only one thing which coax cannot: versatility. Installed in a

hotel, for instance, UTP can deliver any one of a dozen types of signals. It can be 100baseT for one customer, deliver video for the next, be an Internet access port the next day, all while running automated devices in the room.

Many of these applications can be running on different pairs inside the same cable, "shared sheath", which we touch on below. This table is the comparison with broadband /CATV:

Parameter	7811A	1583A/1700A	1872A	CATV (RG-6)
Attenuation	22 dB @100 MHz	32 dB @200 MHz	40 dB @350 MHz	12 dB @350 MHz
Bandwidth	100 MHz	200 MHz	350 MHz	1 GHz+
Equiv. Channel	Channel 6	Channel 22	Channel 45	Channel 158+
Impedance	$100\Omega \pm 15\Omega$	$100\Omega \pm 12\Omega$	$100\Omega \pm 12\Omega$	$75\Omega$
Capacitance	15 pF/ft	15 pF/ft	15 pF/ft	Unspecified
Gage	24 AWG	24 AWG	24 AWG	Different/CCS
Format	Balanced	Balanced	Balanced	Unbalanced
Conductor	Solid	Solid	Solid	Solid CCS
Construction	UTP	UTP	UTP	Coax

Since broadband/CATV is an unbalanced system a balun is required to run those signals on UTP. It should be noted that not only the cable, but also the balun will be required to handle an extremely wide bandwidth since even standard CATV goes up to 1 GHz . With Belden MediaTwist, we give some specs out to 550 MHz, equivalent to Cable Channel 78. The widest bandwidth balun available is the ETS PV-884, which is specified out to 850 MHz. (Channel 121.)

#### Comparison of Attenuation between UTP and broadband/CATV RG-6 at 100 meters

Cable	50 MHz	100 MHz	200 MHz	350 MHz
RG-6	4.66 dB		9.16 dB	11.9 dB
Category 5	16 dB	22 dB	No data to compare	
Category 5e	15.8 dB	21.7 dB	32 dB	No data
Category 6	15.5 dB	19.9 dB	29.1 dB	40 dB

As you can see, there's really no comparison. UTP cannot go as far as coax, cannot handle as broad a bandwidth as coax. The key advantage to UTP is versatility. Broadband/CATV coax will only be that: coax into your television. It will never connect to your phone, or run an automated factory, or even carry audio. But multimedia cables, such as MediaTwist, can easily do that and more.

#### Shared Sheath Requirements

Shared sheath systems are driven by the "critical signal". This is often the cable with the highest frequency, or possibly the widest bandwidth. The pair with that signal will be the controlling factor for the entire cable.

Since the parameters for all different signals are so varied, it is virtually impossible to predict how multiple signals will interact. But the chart below is a starting point:

**Shared-Sheath Critical Parameters**

A = attenuation

B = bandwidth

C = capacitance

I = impedance/impedance tolerance

X = crosstalk

	Unbalanced Audio	Balanced Audio	Digital audio	Standard Video	Digital SDI Video	RS-422	RS-485	10baseT	100baseT
Unbalanced Audio	C, X	C, X	X	A, I	B, A, I	X, C	X	X	X
Balanced Audio	C, X	C, X	X	A, I	B, A, I	X, C	X	X	X
Digital audio	X	X	A, I	X	B, A, I	I	I	I	X, I
Standard Video	A, I	A, I	X	A, I	B, A, I	A, I	A, I	A, I, X	A, I, X
Digital SDI Video	B, A, I	B, A, I	B, A, I	B, A, I	B, A, I	B, A, I	B, A, I	B, A, I	B, A, I, X
RS-422	X, C	X, C	I	A, I	B, A, I	X	X	X	X
RS-485	X	X	I	A, I	B, A, I	X	X	X	X
10baseT	X	X	I	A, I, X	B, A, I	X	X	X	X
100baseT	X	X	X, I	A, I, X	B, A, I, X	X	X	X	X

You will note that crosstalk is by far the most common critical factor. As frequencies go higher, impedance, bandwidth and attenuation come into play. Capacitance is a critical factor only with audio, but because Category cables are so good, with such low capacitance, capacitance becomes a non-issue with most other signal types.

And, if you intend to do some shared sheath applications, here's where you can start. Fill in the blanks below with the parameters for the signals you intend to feed down the pairs. You have two blanks below, but that could be duplicated to give you four. We have inserted Category 5 specifications, but if you use cable which is 5e or 6, make your own chart and start with those!

Parameter	Category 5
Crosstalk	@ MHz
Impedance	100Ω ± 15Ω
Capacitance	15 pF/ft
Gage	24 AWG
Format	Balanced

**Where Shared Sheath Fails**

Shared-sheath applications fail where UTP itself fails. The limitations are based on the

resistance of 24 AWG pairs. This is obviously why these cables cannot be used for power conductors or speaker cables. These and other similar applications require low resistance.

The second limitation is bandwidth. Where low-loss at high frequencies are required, coaxial cable is still the "king". But UTP, especially enhanced UTP is encroaching on this realm of "coax" and is getting closer all the time. This is one of the reasons that uncompressed broadcast quality HDTV signals are not even mentioned. They run at a bandwidth of 750 MHz, for which no data is available on any UTP. And, even if the UTP were perfect, the 24 AWG resistance would limit HDTV signals to about 90 feet.

Are we done playing with twisted pairs? Absolutely not! Maybe the "next" super UTP will be able to carry broadband/CATV to 500 channels, or uncompressed HDTV, or microwave signals!

If our investigation into twisted pairs has proven anything, it is that this transmission medium is far from dead!

### Other New Systems

There are new networking systems emerging such IEEE 1394 "Firewire™". This is a hot-swap "hubless" network scheme mainly for consumers, but it may have limited professional applications as well. While the standard cable looks nothing like Category 5, the IEEE Committee is currently considering Category 5 as an alternate wiring method.

Since the cable carries signals and power, the limitation to distance is based on resistance of 24 AWG UTP. Even then, it is felt that the distance currently specified between devices (4.5m, or 15 ft.) could be increased up to (45m or 150 ft.) with Category 5. The trick may be to double-up the conductors used to carry power, thus cutting the resistance in half.

### So What Do I Need to Run...

Application	Balun?	ETS Part #	Comments
10baseT	No		
100baseT	No		
Gigabit Ethernet™	No		No shared sheath
Wideband™	No		No shared sheath
Analog Consumer Audio	Yes	PA-800 series	
Analog Balanced Audio	No		Forced balancing option
Digital Audio (balanced)	No		Forced balancing option
Digital Audio (coax)	Yes	PA-810 series	XLR to BNC
Analog video	Yes	PV-860 series	Bandwidth 4.5 MHz
Analog video	Yes	PV-840	Bandwidth 60 MHz
RGB-S	Yes	PV-890 series	BNC or HD-9
S-Video* plus stereo audio	Yes	PV-902	consumer unbalanced
Audio + Video (baseband)	Yes	PV-900	consumer = RCA jacks
Digital video	Yes	PV-850	(270Mbps/135 MHz)
Broadband/CATV	Yes	PV-882 series	Cable Channel 77
Broadband/CATV	Yes	PV-884 series	Cable Channel 121

\* Also known as Y/C or S-VHS<sup>TM</sup>. VHS is a trademark of JVC. Ethernet is a trademark of Xerox Corp. Wideband is a trademark of Wideband Corp.

Thanks to ETS (Energy Transformation Systems) for their work on UTP baluns. They can be reached at [www.etslan.com](http://www.etslan.com), 1-800-752-8208

**And it's not just ETS...**

There are many other balun manufacturers. Many of them can be found on Belden's web page in the white paper "Video and UTP". You can find it at [www.belden.com/Video and UTP.pdf](http://www.belden.com/Video and UTP.pdf).

**We're Interested Too!**

Are you planning an installation of UTP for a non-data application not mentioned in this paper? The author would be very interested in talking to you. If you have any questions or comments on the contents of this paper, contact the author at [Steve.Lampen@belden.com](mailto:Steve.Lampen@belden.com).

# Knekt System Installation Manual.

Rev 2.00 (18th November 1996)

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## INTRODUCTION:

The Linn Knekt/Intersekt family of products enables a customer to gain greater benefit from their investment in high quality audio and video systems. This is done by distributing high quality sound and full control of the system all round their home. With the addition of easy to install modules and wiring they can get high quality sound from any source in your *main system* to anywhere in their house, with complete control. All the Knekt products are compact and can be installed virtually invisibly. To complement the electronic modules the Sekrit in-wall loudspeaker fits discreetly into stud partition walls but gives the sound quality expected from floor standing Hi-Fi loudspeakers.

The Knekt system builds on the technology and facilities designed into Linn electronics, solid state switching, microprocessor control, using a low cost, easy to install, reliable cabling system extends quality sound with control all round a home. The modular design uses the same cabling system from the simplest system right up to the most powerful, largest home automation installations. Thus allowing a system to be upgraded, when required, with minimal disruption to the home.

This manual describes in detail how to install the Knekt system, the wiring, the components and contains lots of useful information. Please let us know if there are errors and any useful hints and advice we should add to this manual.

## TERMINOLOGY:

**Knekt:** the family name for all the components of the Linn multiroom system.

**Sneaky modules:** Line Drivers or Line Receivers that can be plugged into the back of a Majik-I control amplifier.

**Stand-alone:** self contained Line Drivers and Line Receivers, in their own cases. Usually linked with Kairn / LK100 based **Main** and **Room** systems.

**Line Driver :** a unit in either Sneaky or Standalone format, located at the **main system**, which distributes audio and control signals to four Rooms. Directs control signals from the four Rooms to Linn sources in the Main System using the Linn 'remote out / remote in' loop or to other equipment through infra red transmitters.

**Knekt-D :** A Line Driver in Standalone format.

**Line Receiver:** a unit in either Sneaky or Standalone format, located in each remote room, which receives audio and control signals from a Line Driver in the **main system**. Then directs control signals from a remote room to sources in the remote room or to sources in the **main system**.

**Knekt-R :** A Line Receiver in Standalone format.

**Main System:** the main listening location containing the main source components and a Line Driver.

**Room :** any location other than the **main System** location, containing a Line Receiver, power amplification and loudspeakers.

**RCU:** Room Control Unit. A wall mounted control panel with eleven buttons, an infra red receiver and a display. A computer the size of a light switch! The RCU 'emulates' the front panel of your source and control components, (Kairn, Kremlin, Karik and non Linn equipment). The RCU allows you to control the system in a very powerful but simple to use manner. It shows you the status of the system; what frequency the Kremlin is tuned to, what track number the Karik is playing and much, much more.....

**Line Remote:** The connection system that transfers control and status information between Linn control and source products.

**Matrix Switcher (Intersekt):** A powerful, modular matrix switch allowing the connection of any source, with its associated bi-directional control signals, to any room, or rooms.

## Planning the Installation.

The Knekt system is completely modular and upgradeable. It can be expanded in both size and functionality. There is a major functional jump between a Line Driver based system and a Matrix based system. The Line Driver system sends the same audio signal to all the rooms. This signal can be any one of the sources in the Main System, but the same signal goes to all rooms. Every room has full control of the selection of the source and the source itself. With the Matrix any source can go to any room, simultaneously, with full control of the source. You must be aware of this difference and be sure your customers understand. The Line Driver is intended for small installations (nominally 4 rooms but can be configured for 8 rooms if no RCU is required in the main system). The Matrix can be expanded up to 24 sources and hundreds of rooms.

Despite this difference the same wiring is used, simplifying the installation and allowing later upgrades. If a new house is being wired for a simple multi-room system, it is worthwhile wiring every room at the same time, even where no music is required. Since the cost of the materials is minimal, and upgrades may be performed later without disturbing the house.

There is no one single way of installing a LINN multi-room system, indeed it is likely that no two systems will be the same. So flexibility and simplicity are most important, and the LINN system has been designed to achieve this. This means a little more complexity has been added to the electronics, allowing simpler cabling to be used, while keeping the highest quality.

Loudspeakers: Obviously loudspeakers are needed as part of any multiroom system. This document does not cover the wiring for in-wall speakers nor the fitting of them. See the instructions supplied with the loudspeakers.

Safety. To install the Knekt system you will be disturbing your customers home, feeding cables through floors, cutting holes in walls, adding power outlets, fitting in-wall loudspeakers, concealing electronics. You must have your and your customers' safety in mind continuously. Use the recommended materials, especially wiring which meets local fire hazard requirements. Work carefully. Test everything before your customer does.

Remember **"if it's not tested it doesn't work"**.

Here is an example of a typical installation, with full instructions for its wiring and some alternative ideas.

## PLANNING A SIMPLE MULTI-ROOM SYSTEM.

In this example, the customer is buying a LINN main system, with a KAIRN preamplifier or a MAJIK-I integrated amplifier, and wants LINN sound quality throughout the house. We recommend that the procedure here is followed, although there are various options that will be described later.

## PERMANENT MULTI-ROOM WIRING.

A pattress is fitted to the wall, concealed behind the main system. In Britain, this is the same size as a double switched mains socket, and it provides up to six RJ45 sockets, similar to telephone sockets. (There is no confusion, as UK telephone plugs will not fit). If you need more sockets, add a second one or make up a custom faceplate.

From each socket, a cable runs inside the wall to each room in the house, to a convenient place to install the room's electronics. Here it terminates in one of a pair of RJ45 sockets (the right hand one) on a single pattress. For the best results, this cable should be 4-pair solid core twisted pair cable.

From the second (left hand) socket, a flat 8-way cable (no more than 30m, or 100 feet, if possible) runs inside the wall, round the room to the control point. This is a double width pattress, in a prominent position, perhaps next to the light switch. Unlike the others, it is not a standard box, but one supplied by Linn, to suit both British and American standards. It fits into a hole 99mm wide, 77mm high and 46 mm deep, and can be fitted with a faceplate to match either standard. You need 100-250 mm of cable loose inside the pattress. Terminate this cable in an RJ45 plug. If the room is not part of the multi-room system, the socket may be covered with a normal blank faceplate or concealed to allow later upgrades.

**Plan the wire route to AVOID running beside Mains/Power cables, appliances with motors, Dimmer switches, TV sets or anything that can produce Radio noise. We've seen Fans, Refridgerators and Dimmer switches totally confuse the system and degrade the sound!, so AVOID!!!!**

This is all the essential wiring for any Knekt system.

## PLANNING A ROOM.

With your customer work out where the loudspeakers will go and which types are required.

Next work out where the electronics will be located. Ensure that there is adequate ventilation and fit power outlets where necessary.

Loudspeaker wiring may be run from in-wall speakers through the wall to speaker sockets on a pattress next to the RJ45 sockets.

The room electronics can be either:

a MAJIK-I control amplifier, fitted with a line receiver card, (needs one power point) or a KNEKT line receiver (a simple preamplifier) and a power amplifier, (needs 2 power points with Ground/Earth connection for Knekt-R).

Up to three local sound sources in the room (e.g. TV, cassette) may be fed through the room system. Each room has its own complete Hi-Fi system as well as access to the main system. Plan the signal wiring from these sources to the line receiver, and their power points.

The simplest possible system uses the MAJIK-I to relay remote control commands back to the main system, instead of the room control unit (RCU). This can save the cost of an RCU, where a room is not regularly used. The MAJIK-I cannot of course be completely hidden as it needs to see the infra red remote control signals.

With this system there is no way of seeing what the main system is doing. Sources can only be selected and controlled by listening. Wire the room for an RCU at a suitable place in case the customer wants to upgrade the system in the future.

## WIRING THE PLUGS AND SOCKETS.

To understand the wiring convention, take a short length of FCC68 cable, strip back some of its outer sleeving, and lay it flat. Put a plug at each end, with the spring clip upwards. Note that, because the plugs are facing in opposite directions, the eight wires go into each plug **IN THE OPPOSITE ORDER**. This is how all FCC68 plug-plug leads are wired.

See the illustration in the colour section at the end.

If you take two of these leads, and one with a socket on each end, you can connect them together to form a long lead with a plug on each end. To do this, the sockets must also be wired in the opposite order. (Three swaps equals one swap!)

If you take a plug-plug lead, and wish to extend it with another lead, that lead must have a socket on one end and a plug on the other. This time, the connections must be wired in the **SAME** order - because two swaps would cancel out, and we need one swap.

## COLOUR CODES

### NOTE -

1. There are two slightly different FCC68 colour codes. Stick to one supplier and you only need to know about one of them.
2. The twisted pair codes must be followed, to keep the audio and control signals on separate pairs.

### FCC68 Cable colour codes.

Conductor	1	2	3	4	5	6	7	8
Type 1 -	White	Orange	Black	Red	Green	Yellow	Blue	Brown
Type 2 -	Blue	Orange	Black	Red	Green	Yellow	Brown	White

### Twisted pair colour code (British Telecom CW1308 wire).

Conductor	1	2	3	4	5	6	7	8
Colour	White/ Blue	White/ Orange	Orange	Blue	Green	Brown	White/ Brown	White/ Green

### Keep the twisted pairs in the order ,

- 1st Pair to connector pins 1 & 4,
- 2nd Pair to connector pins 2 & 3,
- 3rd Pair to connector pins 5 & 8 and
- 4th Pair to connector pins 6 & 7.

## WIRING SHORT FCC68 PLUG-PLUG LEADS.

Short leads are invariably flat FCC68 cable, with a plug at each end. The plug is fitted in one operation with a purpose-made tool.

1. Cut the required length of cable.
2. Using the recommended tool, strip the sleeve off one end, taking care not to damage the insulation on each wire inside. (If you do, cut the end off and start again).
3. Before fitting the plug, check the colour codes of the inner wires, against the list above. Occasionally the cable kinks, and two wires swap over inside the sleeve.
4. Fit a plug to this end - see instructions with the tool. Some cables have a ridge to identify one side of the cable - fit the plug so that this is on the same side as the spring clip.
5. Check that the cable grip inside the plug is firmly squeezing the cable sleeve, and that the gold contacts have bitten into all the wire ends (often they go right through). None of the gold contacts should stand higher than the others, and they should all be below the plastic dividers.
6. Strip the other end, and check for the same colour code.
7. Fit the second plug, taking care to keep the ridge on the same side, so that the colour code is reversed.
8. Check it as before.
9. Test the finished lead with the SLT-3 line tester ( see TESTING THE WIRING later).

Alternatively, curly cables are available in the UK, ready-made from Farnell, to cover 2-6 feet or 4-12 feet.

## WIRING THE MAIN SYSTEM SOCKETS.

For ease of connection and reliability, we strongly recommend that Krone sockets are used throughout. These are IDC (insulation displacement) sockets, which give extremely reliable connections when used with the correct tool. Each socket has a label, protected by a transparent cover.

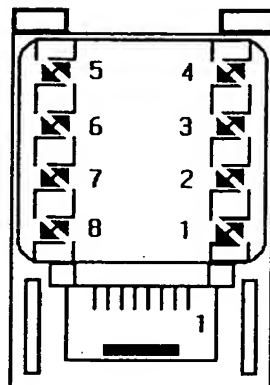
They are wired as follows, using 4-pair twisted pair cable.

1. Strip back about 2" (5cm) of outer sleeving.
2. Attach the cable to the socket with a cable tie, about 1/4" (6mm) back from the end of the outer sleeving.
3. Referring to the right section on the colour code sheet, hold Wire 1 in place on the terminal and make the connection with the appropriate tool..(Using the KRONE tool, ensure the wire is fed through the cutter, to trim it to length in the same operation)
4. Repeat for wires 2 through 8.
5. Ensure the cable tie is tight.
6. Trim the cable tie and any loose ends to length.
7. The wiring will be tested later, when the room wiring is complete.



## PIN NUMBERING ON THE IDC TERMINALS OF KRONE SOCKETS.

The socket is seen from the rear. The plug enters from the other side of the page, with its contacts up and its spring clip down.



## WIRING THE ROOM SOCKETS

Wire the right hand socket to the cable from the main room.

The procedure is the same, except that the wiring order is reversed, so

Wire 1 goes to Pin 8,

Wire 2 goes to Pin 7,

....

Wire 8 goes to Pin 1.

Wire the left hand socket to the flat FCC68 cable from the control point. The procedure is the same as for the right hand (audio) socket, with the same wiring order, even though the flat cable has a different colour code.

Now wire up a plug as a guide on a spare piece of FCC68 cable. When the plug is inserted in the left hand socket, Wire 1 on the plug goes into Pin 1 on the socket, and connects to the same colour of wire leading from the socket. Alternatively try both ends of a short plug-plug cable, and mark the right plug.

For example, if the wire connected to pin 1 on the socket is brown, the brown wire is at the end of the plug nearest to Pin 1 on the socket, when plugged in.

Fit a plug onto the other end of the FCC68 cable, (in the Linn-supplied pattress for the control panel), the same way round as the plug you are using as a guide.

## THE WIRING TESTER.

The SLT-3 wiring tester is recommended as the best and easiest way to test the wiring..

This is supplied in 2 parts, a Master unit and a Remote unit, and is powered from a battery in the Master unit. There are 3 sockets at the top of each unit - we use the socket labelled USOC. This tester tests the cable two wires (one pair) at a time.

To test a plug-plug lead, plug one end in the USOC socket on the Master unit, and the other end in the Remote USOC socket. The tester will automatically start, and the green lights on the master will cycle round 1-2-3-4. The RED lights on the Remote unit should do the same - to show that the connections are reversed, as described previously. If this is not what happens, the wiring is faulty, as described in more detail below.

To test a socket, use a (tested!) plug-plug lead to connect it to the tester.

## TESTING THE WIRING.

Start by testing all the plug-plug leads you will be using.

Next, test each room's wiring in turn.

1. Connect the plug for the control panel into the REMOTE unit of the tester, using the socket labelled USOC.
2. Connect the MASTER unit (using a plug-plug lead) into the left hand KRONE socket where the room electronics will be. Verify that the lights are cycling correctly at both ends of the cable, and label that socket "CONTROL". (If there is no response, try the right hand socket! It does not matter if the sockets are swapped, as long as they are correctly labelled).
3. Label the other socket "AUDIO" and plug in the MASTER unit.
4. Take the REMOTE unit to the main system room, and plug it into each socket in turn. Verify that there is no response from all sockets except the right one, and that the right one is correctly wired at both ends. Label that socket with the name of that room.
5. Repeat this process for the other rooms.

## FAULT DIAGNOSIS WITH THE SLT-3 WIRING TESTER.

If the lights do not cycle correctly as described above, the following notes will help to diagnose the fault.

If one of the lights (the same light at each end) does not illuminate, one pair of wires is broken (open-circuit).

Wires are grouped in pairs as below.

Light 1	Wires 4 and 5 (the middle ones on a flat cable)
Light 2	Wires 3 and 6
Light 3	Wires 2 and 7
Light 4	Wires 1 and 8 ( the outer ones on a flat cable)

If light 3 does not illuminate for example, then wire 2 or wire 7 (or both!) is faulty.

If one light is unusually bright at the master, (and not lit at the remote end). Then there is a short circuit between the two wires of that pair.

If two lights illuminate at once, or one comes on twice, then there is a short circuit between wires on two different pairs.

If lights are out of sequence, e.g. 1-4-3-2, then pairs of wires have been swapped (check the colour code!) or the socket labelled 258 is being used at one end of the tester.

If a green light appears on the remote unit - two wires in a pair have been swapped. Fix the fault and re-test before continuing. See the tester instructions for more information.

It may be helpful to wire both sockets on a spare dual socket together, and make some deliberate mistakes, to understand the tester. The Krone sockets can take two wires in each terminal, and they can withstand quite a few re-uses. The wiring tool has a hook for removing connections, so this is quick and easy to practise.

## **VARIOUS INSTALLATION OPTIONS.**

### **FCC68 cable used throughout the system?**

We recommend the use of twisted-pair cable ( BT CW1308 or CAT5 ) for the audio wiring. Higher quality/reliability is possible with the twisted pair cable. The drawback to really long runs of FCC68 cable is adding an amount of noise, audible with the volume high, while the remote control is being used.

### **Bypassing wall sockets.**

If the electronics is to be hidden in a cupboard, you can dispense with the pair of RJ45 sockets in the room. Simply run cables through a hole in the wall and fit plugs onto them, to plug into the product. The same would apply to loudspeaker cables from the in-wall loudspeakers. Mains should be supplied via normal sockets in the cupboard and a normal power cord to the products. The cupboard **MUST** provide adequate ventilation for a power amplifier.

### **Additional RCU's.**

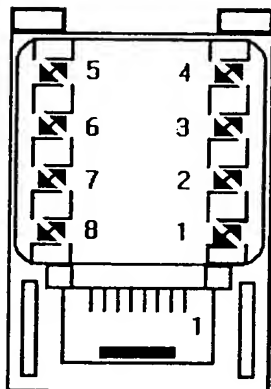
There may be cases where two rooms are fed with the same signal, such as a bedroom and a bathroom, and the system must be controllable from both rooms. It is possible to add a second RCU, mounted in a pattress in the second room. It is connected to the other RCU via an FCC68 lead in the wall, with a plug on each end: NOT back to the main system.

### **Alternative RJ45 sockets.**

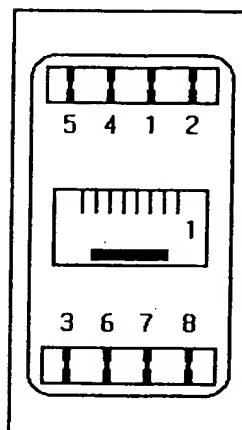
The KRONE sockets are recommended because they seem to be the highest quality and best value, and the easiest to wire up, and the most reliable. However, there are other types, such as the EUROMOD sockets, which may give a wider range of installation options. Both are listed in the next section "Where to get the components", and both may be wired with either flat FCC68 cable or twisted pair cable.

Both types of socket are illustrated below. They are seen from the rear. The plug enters from the other side of the page, with its contacts up and its spring clip down. Note that Krone sockets have numbered terminals, while EuroMod sockets do not, and their terminals are not in order.

KRONE SOCKET



EUROMOD SOCKET



## **WHERE TO GET THE COMPONENTS.**

At the end of this section we have listed suitable components from some popular British suppliers, as found in the catalogues listed below. Outside Britain, your national distributor should be able to advise you on suitable suppliers and components.

If you have to wade through other catalogues to find the right components, you will need to satisfy yourself that the specifications below are met. If you encounter problems, please contact Linn Products for help.

### **BRITISH CATALOGUES**

If you have a different issue of a particular catalogue, the page numbers will be different, although the components will appear in the same section and have the same part number.

#### **FARNELL**

FARNELL Electronics, Canal Road, Leeds, West Yorkshire LS12 2TU  
Tel 01532 636311.

### **WIRING TESTER**

A wiring tester is available from:-

RS

Part No. 463-732

Mod-Tap SLT3 tester approx. £99.00

### **CABLE MARKERS**

For 8 way flat cables: Critchley 'K' type markers, black print on a yellow sleeve. Code 1361. For phono leads: Critchley 'C' type markers, black print on a white body. Code 0599. Manufacturer: Critchley (GB) Ltd, Brimscombe, Stroud, Gloucestershire GL5 2TH, England. Fax: 01453 885167. Phone: 01453 882451  
Critchley will supply a list of world-wide distributors.

## CABLE SPECIFICATIONS

This covers physical and electrical specifications only. These cables may or may not meet the appropriate safety regulations including fire hazard, flammability and smoke generation standards.

Please ensure that any installation meets the regulations in force in your country.

### FLAT (FCC68) CABLE

The flat cable may be terminated in a plug, or on a wall-mounting socket. It is used wherever the cable must terminate in a plug at either end, that is a SHORT cable run!

This includes :-

- connections to an RCU, where the cable is buried in the wall,
- all flying leads, between Linn multi-room products and wall sockets,
- connections where the multi-room products are hidden, perhaps in a cupboard, and the cable runs straight from product to product via holes in the wall.

It can be used for all cabling. But over long distances (> 2 metres ), the round 4-pair cable offers better results. The round 4-pair cable is easier to run in cable ducts.

Flat 8-way cable is available in several different varieties, all are known as FCC68 cable, but not all are suitable.

NOTE - FCC68 is an American specification for flat cable, with 4,6 or 8 conductors. Only the 8-way version (8 conductors) is suitable.

The conductors will be one of two sizes.

- a) 30 a.w.g stranded wire - this is too thin and will not make reliable connections in the recommended plugs or sockets.
- b) 28 a.w.g stranded, or 7/0.15mm to 7/0.16mm (actually 27 to 26 a.w.g.). This is the only suitable type.

There are two different colour codes. That is, each wire in the cable is coloured to allow identification, but the colours are in a different order for the two types of cable. This does not matter, except to add potential confusion to an installation. If you always buy from the same supplier this should be no problem.

Conductor	1	2	3	4	5	6	7	8
Type 1 -	White	Orange	Black	Red	Green	Yellow	Blue	Brown
Type 2 -	Blue	Orange	Black	Red	Green	Yellow	Brown	White

NOTE - the four colours in the middle are the same, whichever type you have.  
 - sometimes the white wire is grey, to add further confusion.

To sum up - to work out if a flat cable is suitable, ask yourself -

Is it an 8-way (8 core) cable?

Is it an FCC68 cable?

Are the conductors 28 a.w.g. or 7/0.15mm stranded copper?

If the answers are all YES, the cable is suitable.

### SUITABLE CABLES

Farnell ,      Part No. 717-319      100m reel (FCC 68 type 2)

Part No. 277-551      "10 ft" (2-6 ft.) curly lead

The Farnell cable seems less prone to swapping conductors than some.

Radiospares      Part no. 365-228      100m reel (FCC 68)  
 (AMP 641660 standard)



## ROUND 4-PAIR CABLE

(BT) specification CW1308 or CAT5

The single-core CAT5 and BT cable CANNOT be terminated in a FCC68 style plug. Multi-core CAT5 cable CAN be terminated in some styles of FCC68 plugs.

The twisted pair cable is suitable for ALL audio runs, with better balance (less interference) and less audible noise from the control signals. Being round, and only 6mm dia, it is less prone to kinking when it is run through cable ducts.

Use it from a wall socket behind the main system to a wall socket behind the volume box.

BT specification CW1308 covers cables other than 4-pair cable - so specify 4-pair (8 conductor) cable. Each conductor is a single 0.5mm strand of copper. There is an LSF (Low Smoke and Flame) equivalent, BT Spec. CW1600, which may be required by certain regulatory organisations.

CAT5 specification covers single-core twisted pairs, multi-core twisted pair, foil Screened single-core twisted pair and multi-core screened twisted pair. There is also a LSF equivalent, EIA/IA568A, TSB36 that may be required for certain regulatory organisations.

The colour code identifies the wires in pairs, i.e. Blue and White/Blue form a pair. (White/Blue denotes a white wire with blue marks on it. The blue wire has faint white marks too.)

"Live"	"Neutral"
Blue	White/Blue
Orange	White/Orange
Green	White/Green
Brown	White/Brown

It is important that the pairing is correctly used.

### SUITABLE CABLES

Farnell	Part no. 148-941	100m reel CW1308
	Part no. 436-768	100m reel CAT5 LSF (Single)
	Part no. 583-200	100m reel CAT5 Patch (Multi)
	Part no. 583-340	1000m reel CAT5 Screened (Single)
	Part no. 583-273	100m reel CAT 5 Screened (Multi)
Radiospares	Part no. 368-435	100m reel CW1308
	Part no. 365-278	100m reel CW1600
	Part no. 369-810	100m reel Trunk/non-flexible cable
	Part no. 369-860	100m reel patch/flexible cable

## CONNECTORS

Plugs are 8-way FCC68 plugs, also known as RJ45 plugs. These should be the long-body (about 1 inch), non-keyed variety. A plug is fitted in one operation with a special tool. Most plugs may only be fitted to the flat FCC68 cable. Some are designed for the round solid-core cable, but we have not yet tried these.

### SUITABLE PLUGS -

Radiospares	Part no. 477-321	RJ45 plug for solid or stranded wire (CAT 5)
	Part no. 455-258	RJ45 plug for AMP cable
Farnell	Part no. 106-310	Flag FCC68 Flat Cable
	Part no. 429-867	RJ45 plug

### PLUG FITTING TOOLS

Radiospares	Part no. 486-072	Tool for plug 477-321( req. Chuck!)
	Part no. 464-915	Chuck for plug 477-321 and Tool
Farnell	Part no. 107-373	Tool CT8 for 8-way FCC68 plug
	Part no. 429-879	Crimp for above tool and crimp
	Part no. 429-909	for Farnell Plug 429-867

## SOCKETS

Normally for connection to a line receiver a double RJ45 socket will be fitted to the wall. These double outlets look very much like a single mains outlet. A standard BS1363 pattress (one inch deep) is required, either buried in the wall or fitted onto it, with the RJ45 outlet replacing the mains socket. One socket is wired (with 4-pair cable) back to the main system, the other is wired to the RCU with flat cable.

At the main system, several dual outlets may be used. Alternatively EUROMOD provide a double-width faceplate that accepts four sockets, or eight using the dual socket. However, we recommend KRONE sockets, which has a wider availability (in Europe) and a well-designed IDC tool. Krone makes a trunking outlet that fits into a custom faceplate. Linn will supply 4 and 6-way faceplates to fit these.

Each conductor is connected to a pin on the socket individually, with a tool designed for that make of socket. We currently use KRONE sockets (or equivalent, LSA type) with the KRONE tool, which does not fit EUROMOD connectors. The EUROMOD IDC tool can be used with care, but we are looking around for a more universal tool. The cheap plastic tools are not recommended.

### KRONE sockets

(recommended)

Radiospares	Part 406-442	Krone dual outlet
	Part 470-128	"professional" (Krone) tool
Farnell	Part No. 574-818	Krone Faceplate (req. sockets!)
	Part No. 574-820	Krone SINGLE socket (2 req. for faceplate)
	Part No. 574-831	Krone SINGLE Blanking plate (for unused socket locations in faceplate)
	Part No. 467-674	Krone tool (BT type 2A)

The KRONE trunking outlet is fitted into the four- or six-way faceplate at the main system. One is required for each room to be wired up.

### EUROMOD sockets

Radiospares	Part No.463-568	single faceplate (takes 2 sockets)
	Part No.463-574	double faceplate (takes 4 sockets)
	Part No.463-603	RJ45 socket
	Part No.463-710	blank panel (same size as socket)
	Part No.468-482	EUROMOD IDC tool

MOD-SNAP connectors: We do not recommend these.

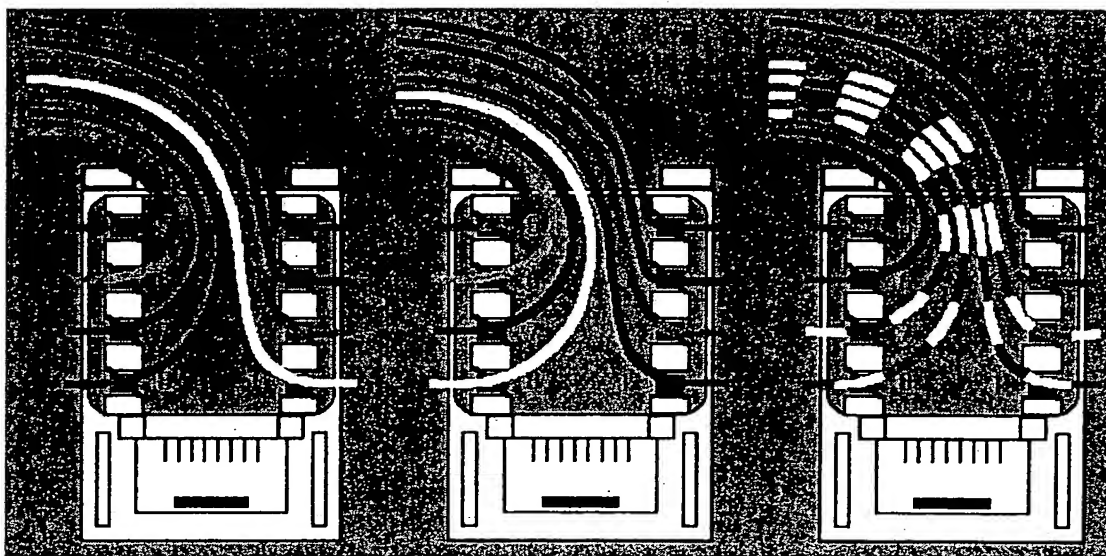
## WIRING COLOURS

### SHORT FCC68 PLUG LEAD



### MAIN SYSTEM WIRING

(using KRONE IDC sockets.)



FCC68 (flat) type 1 cable    FCC68 (flat) type 2 cable    BT CW1308, CAT5 (twisted pair) cable

Note the pairing used with the BT or CAT5 cable.

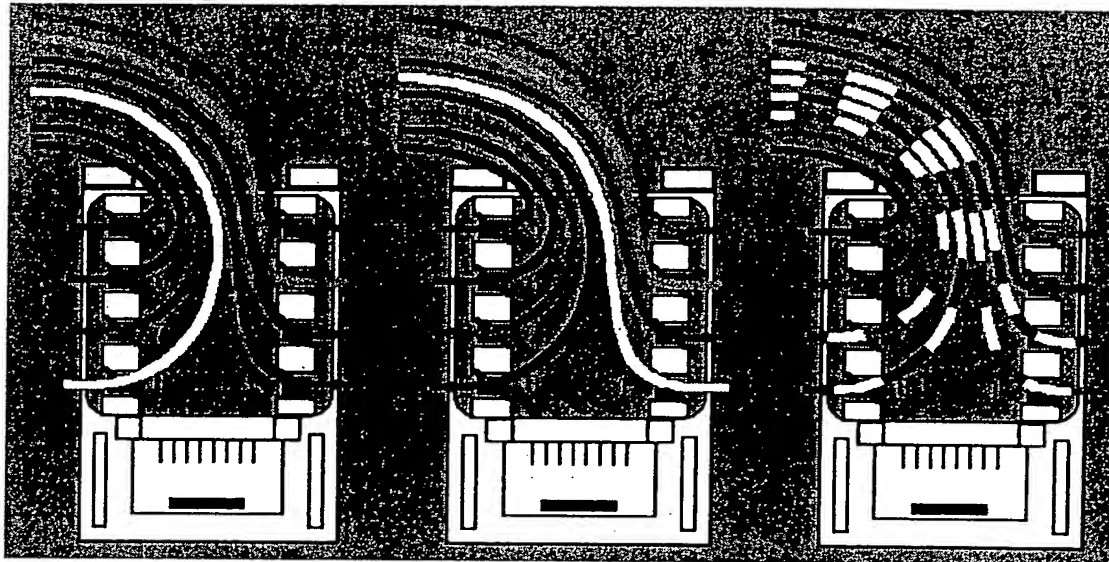
- pins 1 and 4 are a Pair,
- pins 2 and 3 are a Pair,
- pins 5 and 8 are a Pair and
- pins 6 and 7 are a Pair.

*This is done to improve NOISE IMMUNITY in the Audio (Pairs 2/3, 6/7) and Remote control (Pairs 1/4 and 5/7)!*

# ROOM SYSTEM WIRING

(using KRONE IDC sockets.)

Each room has a pair of these sockets. The right hand one is connected to the main audio system, while the left hand one connects to the control panel. Both sockets use the same wiring order.



FCC68 (flat) type 1 cable    FCC68 (flat) type 2 cable    BT CW1308 (twisted pair) cable

Note that :

pins 1 and 8 are swapped,  
pins 2 and 7 are swapped,  
pins 3 and 6 are swapped,  
pins 4 and 5 are swapped,

when compared to the main system socket wiring above.

## Installation.

### SYSTEM INSTALLATION.

When the wiring has been completed and tested, the system can be installed. Install the rooms' first, then the main system.

### ROOM INSTALLATION.

Connect the MAJIK-I or KNEKT line receiver's audio input to the main system (right hand RJ45 socket on the wall) via a short FCC68 cable. Then connect the control input to the left hand (room control) RJ45 socket. Wire up mains, (power amplifier if using the KNEKT line receiver) and speakers.

If required, install a room control unit (RCU) in the pattress at the control point. Plug the cable into the RCU, and mount the RCU in the pattress. Ensure that the RCU is correctly controlling the room electronics - it should be able to adjust the volume up and down, and control any local sources. Leave the room system powered on while installing the main system.

Repeat for each room in turn.

### MAIN SYSTEM INSTALLATION.

The simple main system is installed as a normal Hi-Fi system, with the addition of the line driver. This is fitted inside the MAJIK-I, but with the Kairn it is a separate small unit, with its audio inputs wired to the Tape 2 outputs of the Kairn. It provides Tape output sockets to connect to a second tape deck.

Connect the Remote Out socket to the Remote In socket on the first LINN product in the system ( e.g. the LINN Kairn). Then connect the Remote Out of that product to the Remote In of the next, and so on. Finally connect the Remote Out of the last product up to the Remote In of the line driver to complete the LINN remote loop.

LINN KLOUT power amplifiers **should not** be part of the loop, as the source components will probably not be powered off, to keep them available around the whole house. Separate remote switching will be available for power amplifiers.

Connect a short FCC68 cable from the first room's wall socket to the first output socket on the line driver. Check the operation light on the line driver - if green, all is well. If it is red, the left and righthand RJ45 jacks in the room (at the other end of the cable) have probably been swapped. Fix the problem and re-check for correct operation.

Repeat for each room's wall socket in turn.

## **FULL MATRIX SYSTEM INSTALLATION.**

The full system is installed by replacing the line driver with the switching matrix. Each source component is fed to a separate input on the matrix, and has its own remote control cables. This allows several tuners or CD players to be controlled independently from different rooms. Each room is connected via a wall socket to a separate output on the matrix.

## **CONFIGURING THE ELECTRONICS.**

### **Line Driver:**

1. The Line Driver can be configured to be either a single Line Driver in a four room system or a second Line Driver in an eight room system. The shorting Links P602 and P603 control this.

As a single Line Driver or the first one in an eight room system, fit both links to the left hand pins viewed from the back panel connectors. This is the normal setting.

As a second Line Driver move both links to the right hand position, viewed from the back panel connectors.

2. As a Sneaky it is possible to disable the IR remote sensor. Do this when there is also an RCU in the main system or there will be conflict between the IR signals. To disable the Majik IR sensor add a shorting link to P604.

3. As a Sneaky it is possible to use the IR sensor in the Majik to pass remote control signals to both Linn sources (through the remote in/out sockets). Then to non Linn sources (through the IR transmitter sockets). Use this if the Majik sensor is the only one visible.

To pass remote control commands from the Majik sensor to both Linn and non Linn sources in the main system put a shorting link on to the left hand pins of P601, viewed from the back panel.

**Line Receiver:**

1. As a Sneaky it is possible to disable the Majik remote sensor. Use this when there is an RCU in the room. To disable the IR remote sensor in the Majik put a shorting link on to P603. (centre of board)
2. As a Sneaky it is possible to select whether the Majik sensor or the RCU sensor picks up commands to control local products. With an RCU present put a shorting link on to the right hand pins of P604. With no RCU, or if the RCU and Majik are not likely to receive the same IR signal (they're far apart) put a shorting link on to the left hand pins of P604 (front of board).
3. With a Sneaky Line Receiver it is possible to fit an RCU inside a Majik. Simply replace the Majik front panel (four screws) with an RCU. If you do this you must remove the four links on P5. This also allows the use of a second RCU, connected to the RCU port.
4. With the Stand-alone Line Receiver ensure that the Earth Terminal IS Earthed. The Power supply doesn't carry a mains earth and in most cases the Power Amps do NOT have the audio IN grounded. Without this can make the RJ45 cable act like an Aerial.

**RCU:**

The RCU is entirely software configured using a program running on a PC.

**Linn Audio Products:**

If a RCU is present in that Room, ensure that ALL the IR detectors on the Kairn/Karik/Majik/Kremlin/Kudos/Wakonda/Mimik are disabled.

If NO RCU is in that Room, disable ALL but one product IR detectors. That is, leave one Product that CAN receive IR in the room. This product should be the FIRST one on the Linn Line Remote Loop!

Also check that the Products have the correct software installed for use in multi-room systems. Check the Software Revisions section later on in this document.



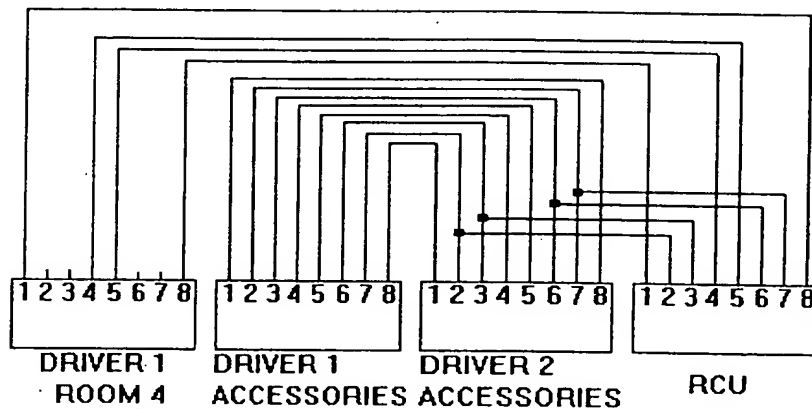
**Other Manufacturers Products:**

As there is no standard for communication between consumer products. The only way to control products other than from Linn is through Infra Red transmitting diodes (sometimes called flashers) which the product responds to as if from a remote control handset. Generally it's best to locate a flasher close to or stuck on to the front panel of a product at its IR sensor. Most remote control systems transmit pulses of modulated IR. The modulation allows the receiver to be tuned, making it more sensitive to the IR signal and less to everything else. Generally the modulation frequency is about 38kHz. There is an adjustment in both the Line Driver and Receiver for the modulation frequency which we re-transmit to the flashers. This may need to be adjusted for the best response from the equipment being controlled. Send a command to the product from either a Majik remote receiver or from an RCU, ensuring that the product receives only the IR from the flasher. If necessary adjust the modulation frequency until the product responds. A compromise may need to be found between different products. Where possible choose products from the same manufacturer of the same generation. Our receivers are tuned to 38kHz so a handset tuned to another frequency may not be received or may not give good range if being relayed through one of our receivers. This is when the options controlling the IR receivers are useful.

This section will be added to as we gain experience from your feedback on integrating other products.

## HOW TO GET 7 ROOMS AND A MAIN SYSTEM RCU :

By a devious patching of power and control signals it's possible to make one of the 8 rooms from a 2 Line Driver system control the main system. The RCU must be configured as a MAIN SYSTEM RCU. Here's how to do it:



**Fig 1.1 - Wiring Diagram for 7 Room Adapter.**

Connect the audio feed to both Line Driver inputs. Taking the feed for Line Driver 2 from the Tape Out of Driver 1. Only connect the wired remote links and infra-red repeaters to Driver 1. Only Line Driver 1 needs a power supply as Line Driver 2 draws its power from the Driver 1 accessory port.

How it works:

Driver 1 feeds power to Driver 2 and the RCU from its accessory port.

The control signals from/to the RCU appears as Room 4 in Driver 1.

There are several ways to implement this wiring:

1. A four way wall plate may be mounted flush with the wall.
2. Two way wall plates may be mounted flush with the wall.
3. A four way wall plate may be mounted in a surface box with rubber feet on the base.
4. Same as option 2. only with two way surface boxes.
5. Review the Knektips.doc for the Jumper link orientation for Majik in an 8 room system.

### Basic Installations Points to REMEMBER!.

- **Avoid** running cables beside Mains/Power cables. Keep at least 6" away from these cables. This can add a huge amount of noise into the Remote control and/or Audio.
- **Avoid** running cables past appliance's with MOTORS. E.g. Refridgerators, Freezers, Fan Heaters, Jacuzzis etc. Keep the cable at least 9 feet/3 metres away from these Appliances. This again can add an amount of noise into the Remote control and/or Audio, when the appliance operates.
- **Use** twisted pair cable where-ever possible. Make the pairs go to pins 1/4, 2/3, 5/8 and 6/7 on the connectors. This makes the Audio sound better and the Products respond better to commands. (*Keeps you the MASTER!*).
- Check **NO** light source can shine directly at Products/RCU's with enabled IR detectors, ( i.e. They can receive IR remote from their own front panels). The RCU's/Products can mistake the light for someone else's IR remote and send the sunlight/spotlight info ALL round the multi-room system!
- Ensure that Products in different Room **CANNOT** receive IR from other Rooms. That is make sure that an IR remote fired in the Kitchen cannot reflect IR from the mirror into the Lounge and control the Cd player without Knekt!.
- Ensure that any Knekt-R (Stand-alone receiver) **IS** Earthed/Grounded via the Earth terminal on its case!.
- Ensure that the Products have the **CORRECT** software to work in a Multi-room system.

## PROBLEM SOLVING:

The Knekt system can grow to become a very complex system, but very simple to install and operate. Here are a few handy tips to ensure reliable systems:

1. Check the wiring with a proper tester before connecting components together.
2. Infra-red noise. The infra-red remote control receivers in Linn equipment are very sensitive that makes them great to use, without having to point a handset directly at the product. However they are also sensitive to interference. The most common sources of interference are direct sunlight, TVs, computer monitors, low energy light bulbs, bright lights pointing at the products. If you are getting erratic behaviour, try switching off any of these sources or shield the products from direct sunlight. Physical separation from an interfering source is the best cure, if possible. If all else fails it is possible to desensitise the remote receivers.
3. to be added to.....

### Software revisions:

We recommend that all our products used in a system are brought up to the latest software revisions as some of the communications features were not programmed into the earlier products.

Latest software revisions are:

Kairn checksum: IC351/LK2V00

Kremlin checksum: IC351/LK2V00

Karik checksum: 946A

Mimik checksum: 97DF

The Checksums are printed on labels stuck on the memory chips.

To Check the Kairn/Kremlin software WITHOUT opening up the product, do the following:-

1. Switch OFF the Kairn/Kremlin and wait approx. 10 seconds.
2. Now switch the Kairn/Kremlin ON with the "+" button on the front panel held down
3. The Kairn/Kremlin will now reply with the software revision, the creation date and the checksum. For Knekt software should be "r2\_00".

The Karik/Mimik software I'm afraid can only be checked by removing the sleeve and checking the markings on the chips!.

Follow instructions in the Linn Service Manual for upgrading software, observing antistatic procedures.

## TECHNICAL DESCRIPTIONS:

### SPECIFICATIONS :

#### Knekt Line Driver:

##### Inputs:

The Sneaky version is internally connected to the record path of the Majik-I.

The Standalone version has an input impedance of 11k Ohms.

Nominal input level 1Volt rms.

Maximum input level 7 Volts peak.

##### Main Outputs:

Fully balanced audio outputs to four rooms plus bi-directional communications.

RJ45 type connectors.

##### Tape Outputs: (standalone only)

Electrically paralleled with the Audio inputs so that when connected to a Kairn based **main system** the tape output used by the Driver is also available for a second tape recorder. Phono (RCA) connectors.

##### Line Remote:

For connection to other Linn equipment to enable bi-directional control and communication. Optically isolated current signalling is used.

##### Infra-red outputs:

Three constant current drives of 3mA on a carrier frequency adjustable between 27kHz and 43kHz, for driving infra-red repeater diodes.

3.5mm miniature jack connectors, centre positive.

##### Accessories connector:

For connection to future Knekt products, or to a second Line Driver for up to 8 room installations or to a Room Control Unit for controlling the **main system**.

Carries bi-directional communications and power.

##### Power Requirements:

The Sneaky draws its power from the Majik-I.

The Standalone operates from a 15Vac, 500mA mains adapter. Nominal power consumption is under 2 Watts. The 500mA capacity is needed to operate an RCU.

There are two input voltages ranges available on the Linn mains adapters: the low voltage one will operate from 90Vac to 132Vac; the high voltage one will operate from 198Vac to 264Vac. The Knekt products are very tolerant of mains supply variations.

The power connector is a 2.5mm coaxial power type.

## **Knekt Line Receiver:**

### **Audio In 1: (Balanced Input from Line Driver)**

Full balanced audio receiver and bi-directional communications on an RJ45 connector.

The Sneaky Line Receiver works in conjunction with the standard facilities on the Majik-I Control Amplifier.

### **Audio In 2,3,4: (standalone only)**

Unbalanced inputs on phono (RCA) connectors.

Input impedance 10k Ohms.

Nominal input level 1 Volt rms.

Maximum input level 7 Volts peak.

### **Audio Output: (standalone only)**

Line output to a power amplifier on phono (RCA) connectors.

Output impedance 200 Ohms.

Nominal Output level 1Volt rms.

Maximum output level 8 Volts peak.

Volume control range 60dB in approximately 1dB steps.

### **Headphone Output: (standalone only)**

To drive headphones of at least 30 Ohms impedance.

Output impedance 35 Ohms. 1/4 inch stereo headphone jack socket.

### **Tape Output: (standalone only)**

Buffered copy of the selected input on phono (RCA) connectors.

Output impedance 100 Ohms.

Output level=1.26 x input level, 1V rms. nominal.

### **Line Remote:**

For connection to other Linn equipment to enable bi-directional control and communication. Optically isolated current signalling is used on phono (RCA) connectors.

### **Infra-red outputs:**

Two constant current drives of 3mA on a carrier frequency adjustable between 27kHz and 43kHz, for driving infra-red repeater diodes.

3.5mm miniature jack connectors, centre positive.

**RCU connector:**

For connection to a Room Control Unit and future Knekt products.  
Carries bi-directional communications and power on an RJ45 connector.

**Ground Terminal:**

The terminal beside the Power Socket is a ground terminal. This should be connected to Mains Earth or a local ground/earth point. This is stop the Main system cable from acting like an Aerial.

**Power Requirements:**

The Sneaky draws its power from the Majik-I.

The Standalone operates from a 15Vac, 500mA mains adapter. Nominal power consumption is under 2 Watts. The 500mA capacity is needed to operate an RCU.

There are two input voltages ranges available on the Linn mains adapters: the low voltage one will operate from 90Vac to 132Vac; the high voltage one will operate from 198Vac to 264Vac. The Knekt products are very tolerant of mains supply variations.

The power connector is a 2.5mm coaxial power type.

**Room Control Unit (RCU):**

The RCU draws its power from the connection to the Line Receiver. It will operate from 16Vdc to 32Vdc, so is very tolerant of voltage variations. The RCU is base on a Hitachi H8 microcontroller, with an electrically re-programmable flash memory containing most of the software. A core of software is programmed into the H8 that allows it to handle upgrades of all the software in the flash memory. A small battery keeps the clock going if the power goes off. Upgrades are done from a program running on a PC that is connected via a small adapter board to the accessory connector on the Line Driver. The data format is RS232 at 19200 baud converted to current signalling. This means that upgrades will take about 5 minutes per RCU. Every RCU has an individual serial number that is programmed into it at manufacture. This serial number is used by the upgrade software to address every RCU in a system individually and to keep a record of the individual configurations of the RCU's in a system.

## Intersekt Specification

### Intersekt R8S8

- Audio Inputs : Audio sources are connected via Phono (RCA) connectors. Each input has an impedance of  $4.7K\Omega$ . Nominal input level  $2V_{rms}$ . Maximum input level 8V peak.
- Remote Control : Bi-directional communication to the sources is via Phono (RCA) connectors. Optically isolated current signalling is used. Remote outputs can be configured as constant current drives of 6mA on a carrier frequency of 36KHz for driving infra-red repeater diodes. A Phono to 3.5mm jack adapter is required.
- Room Outputs : Fully balanced Audio plus bi-directional communications to the rooms are via RJ45 type connectors.
- Tape Outputs : TAPE1 and TAPE2 are buffered copies of the Audio signals to ROOM1 and ROOM2 respectively. Connections are via Phono (RCA) connectors. Each output has an impedance of  $240\Omega$ .
- RCU connector : Bi-directional communications and power for a main room RCU is via the RCU RJ45 type connector. The communication signals are connected in parallel with ROOM1 signals.
- PC connector : Configuration data is transferred via the PC RJ11 type connector. Signals are RS232 compatible.
- Power : The unit is powered from a 110VAC or 240VAC supply (switch selectable) and will operate from 90VAC to 132VAC, or from 198VAC to 264VAC. The nominal power consumption is 14 Watts.



**Intersekt SES8**

- Audio Inputs :** Audio sources are connected via Phono (RCA) connectors. Each input has an impedance of  $4.7K\Omega$ . Nominal input level 2Vrms. Maximum input level 8V peak.
- Remote Control :** Bi-directional communication to the sources is via Phono (RCA) connectors. Optically isolated current signalling is used. Remote outputs can be configured as constant current drives of 6mA on a carrier frequency of 36KHz for driving infra-red repeater diodes. A Phono to 3.5mm jack adapter is required.
- Expansion Signals :** Buffered Audio and remote control signal connections are made via 3 IDC 20 way connectors.
- Power :** The unit is powered from a 110VAC or 240VAC supply (switch selectable) and will operate from 90VAC to 132VAC, or from 198VAC to 264VAC. The nominal power consumption is 5 Watts.

**Intersekt RER16**

- Expansion Signals :** Buffered Audio and remote control signal connections are made via 6 IDC 20 way connectors.
- Room Outputs :** Fully balanced Audio plus bi-directional communications to the rooms are via RJ45 type connectors.
- Tape Outputs :** TAPE1 and TAPE2 are buffered copies of the Audio signals to ROOM1 and ROOM2 respectively. Connections are via Phono (RCA) connectors. Each output has an impedance of  $240\Omega$ .
- RCU connector :** Bi-directional communications and power for a main room RCU is via the RCU RJ45 type connector. The communication signals are connected in parallel with ROOM1 signals.
- PC connector :** Configuration data is transferred via the PC RJ11 type connector. Signals are RS232 compatible.
- Power :** The unit is powered from a 110VAC or 240VAC supply (switch selectable) and will operate from 90VAC to 132VAC, or from 198VAC to 264VAC. The nominal power consumption is 25 Watts.

## The Audio System:

The Knekt system transmits all audio as balanced signals. This enables the use of unscrewed cables which are much easier to install and terminate. The balanced system also eliminates any potential problems with ground loops and has better noise immunity than a conventional unbalanced system.

The Line Driver (or the Matrix output stages) have balanced line driver stages. These convert an unbalanced input to two equal and opposite signals which 'float' relative to ground. They are only referred to ground at DC. These anti-phase signals are sent down the cables to the balanced line receivers. A 'floating' amplifier generates an output which is the *difference* between these signals. Since the wires carrying the signal are side by side for their length they will tend to pick up identical amounts of interference. The differencing amplifier output is (theoretically) zero for identical inputs.

Mathematically:

If the signal is S, and the interfering noise is N:

The transmitted balanced signal is S on one wire and -S on the other.

The output of the differencing amplifier is  $S - (-S) = 2S$ .

If there is interference N on both wires the output of the differencing amplifier is :

$$\begin{aligned}(S+N) - (-S+N) &= 2S + N - N \\ &= 2S\end{aligned}$$

so the noise is cancelled out.

This is the theory, and in practice the better the design of the system the closer to complete cancellation will be achieved. The cost of all this is that the signal has to go through a lot of circuitry, and this is why for normal, short, audio interconnects balanced is inappropriate.

## The Communications System:

The signalling in the Knekt system uses the other 4 wires in the 8 wire interconnect. Two carry data from the main system. Two carry data to the main system. Electrically we use opto-isolated current signalling. At every data transmitter there is an opto-isolator whose output is connected across the data lines. The receiving end is a very low impedance current sensing amplifier. This minimises the voltage pulses on the wiring that minimises the coupling of data to audio. The opto-isolators prevent any chance of ground loops and again isolate the data from the audio. In practice if you turn the volume to maximum in a line receiver you will hear very slight bleeps when you press a button on the handset. The bleep level is way below the music level.

The data format we use is derived from the Philips RC5 remote control standard. We call it Extended RC5. It uses the same format and bi-phase modulation technique but sends up to 80 bit bursts instead of 16 bit bursts. It's not the fastest format but it does allow the possibility of hanging a simple remote eye on to the communications bus and transmitting whatever it picks up, RC5 or any other formats. In practice it's quick enough for controlling and getting feedback from products, is secure against interference and doesn't radiate high frequency noise.

0294027668

PATENT  
Docket No. FBR06132P0010US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	)	A Distributed Stereo System
	)	
Leonard Colin Andrews	)	Group Art Unit: 2644
	)	
Serial No.: 09/485,657	)	
	)	Examiner: Justin I. Michalski
Filed: March 24, 2000	)	

DECLARATION UNDER 37 CFR 1.132

Andrew Goldfinch declares as follows:

1. I am the proprietor of LeisureTech Electronics Pty Ltd, the assignee of the above-referenced United States patent application.

2. The system referred to herein as A-BUS is a distributed stereo audio system using a Category 5 four pair twisted cable to carry at least audio signals and system power from a power supply and source in one room to amplifiers and speakers in another room. The audio signal is carried on two of the pairs of the cable and power is carried on a third pair. ~~The fourth pair can be used for data and status signals.~~ <sup>DATA & STATUS</sup> The attached brochure, entitled "A-BUS Multi-Room Audio Simple Solutions, Create Big Markets", describes the system.

3. The inventor, Leonard Andrews, has a 45 year history in electronics engineering in the audio industry and he has been with LeisureTech Electronics since 1989. I have been in the electronics industry for 38 years, starting in the emerging Hi-Fi market in the mid sixties. I founded LeisureTech Electronics in 1977. In 1991 Len and I decided to look at making products to suit Australian requirements and to protect the company from the fluctuations in the Australian dollar. These products, sold under the Andrew's Audio brand, were well received by our dealers and we received a number of industry awards for them. Today 50% of LeisureTech's sales in Australia are Australian made products developed by Len Andrews and myself.

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4. In 1991 one of our first considerations was to develop a system that eliminated the many weaknesses of traditional distributed audio systems. One of the biggest weaknesses was the losses in long runs of speaker cables from the source components to the speakers in remote rooms. We also did not like the sonic losses that came from autoformer volume controls and impedance matching devices and we were keen to locate the amplifiers as close to the speakers as possible. Despite several attempts at configuring a solution we were limited by cost factors and a number of practical issues. One of the major reasons that manufacturers had not tried to localize the amplification in individual rooms was the difficulty in finding a convenient place to install a bulky amplifier in each room and gain access to AC power which is normally at floor level while the speakers are normally mounted high on the wall or in the ceiling.

5. Our solution was to centralize the power supply to reduce the system cost as one power supply could power multiple amplifiers which would be more compact. In practical terms this did not work as the current drain of the discrete amplifiers we were using at the time was too high and there was no simple cabling method so the project lapsed.

6. When we became aware of category 5 cable, with its eight cores twisted into pairs, it looked to be a solution. We were immediately rebuked for lack of understanding. The twisted pairs did not look like the traditional shielded cables used in the audio industry and the cable was believed too light to carry enough power to power an amplifier.

7. From my experience I was aware that traditional beliefs over power requirements were misplaced, particularly in the US. It was also my belief that if we could deliver high quality line level audio to each room and eliminate the losses which occurred with long cable runs, less volume level would be required. Despite believing the concept would not deliver enough power and having concerns about problems of induced noise, Len Andrews set about developing our concept around category 5 cable. He produced a power module that was small enough to fit in light switch housing or on the back of an In-Wall speaker and he

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eliminated interference problems. These innovations immediately made the concept we were aiming at from the beginning work. The sound quality of the initial unit was not good and the output was limited. But after considerable research Len came up with ample power output for most multi-room requirements and the quality of sound delivered was excellent, well above the traditional speaker level distribution methods. We ended up with a system that delivered huge advantages to system designers, installers and consumers that was delightfully simple in all aspects.

8. The true inventiveness of this system is demonstrated by the advantages that it provides in all areas of distributed audio, in greatly simplifying the whole process.

Only one cable is required to each room.

The quality of sound in traditionally amplified systems is directly related to the quality of cable used (its gauge and insulation) which can not only be costly but also very bulky. If remote control data is required, a separate cable has to be run and often a infrared system has to be installed. A-BUS transmits audio, system power, data and status in one category 5 cable. A cable that has a low profile, a damage resistant outer sheath, is commonly used by installers, has good termination connectors available and is low cost. Most installers have carried out category 5 training and are proficient in installing the product. There are good quality punchdown and RJ-45 connectors commonly available for terminations.

Simple design

A-BUS systems are simple to design, education in audio parameters is not required. Impedance matching is not required. Cable quality is not an issue and data transmission is not an issue as it is built in. Components are connected in a plug and play manner.

Simple Installation

The cost of pre-wiring a home is cheaper and easier. The category 5 cable which installers already have in their trucks is low cost and easy to install. Caution is not required as

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A-BUS is not susceptible to interference when run past other electrical items in the house. The installers also carry termination tools that make installations of A-BUS component very efficient.

### Flexibility

Once a house is wired for A-BUS a variety of components to suit individual applications around the house can be selected and they can be easily changed and upgraded. Sophisticated traditional systems are normally supplied in a standard package with little flexibility so that a minor room would require the same expensive keypad as the more important rooms. After a standard A-BUS pre-wire, the home owner can still make choices as to the quality of sound they require in each room and the flexibility. For instance, a single source A-BUS system can become a multi-source system simply by changing the hub.

### New Markets

The simplicity and flexibility of the system has opened up many new opportunities to the fast growing distributed audio market which is continually short of competent system designers and installers. With A-BUS, a specialist installer is not required to pre-wire a home and the electricians already on site can carry out the installation greatly reducing costs.

9. While these advantages are now well proved in the market and A-BUS has become a worldwide success, getting the technology off the ground was extremely difficult, especially in the US. We had always seen the US as a major market with clear applications for our product. However, when we took A-BUS to the US we had great difficulty in getting anyone to take it seriously. Despite the fact that we were well known to the companies there who should have been most interested in our technology - they looked at it as a "toy" and most qualified industry engineers simply said it was impossible, one even told me that it was simply a matter of physics and while one president of a major "In Wall" speaker manufacturer was keen to take the technology on, his staff would not entertain it and this prevented him proceeding.

10. It was with some in trepidation that we filed an International Patent

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application to extend the filing deadline in the US by a further 18 months. At the time we were very disheartened with no sign of success. In an attempt to overcome the scepticism in the US market we introduced the slogan, "Have you heard it?" and did everything possible to keep the low power output a secret.

11. It was not until I met the new CEO of Russound, who had no technical background, that progress was made. He was concerned that A-BUS could be a possible threat to his large autoformer volume control business. He visited Australia on a sales trip and we were able to give him a good demonstration of A-BUS and show its full potential.

12. Before Russound signed its licensing contract with LeisureTech Electronics they insisted on getting an independent opinion on our patent application. This has also been done by many of our licensees before entering into their license agreements with us. None have come to us with a negative opinion from their patent attorneys.

13. Products made utilising our A-BUS technology were first released in the US in January 2000 at the CES (Consumer Electronics Show) in Las Vegas, over two years after their release in Australia. It was an instant success. It received its first of two Innovation Awards (2001 - 2002). Russound was able to demonstrate the product at the show revealing its qualities in an open noisy environment and proved that A-BUS could produce enough power, but many engineers still continued to consider the technology a 'toy' and system designers saw its simplicity as a threat to their businesses.

14. Russound's introduction of A-BUS products had a major impact in the US market and attracted the interest of people throughout the industry and the press who have recognized its inventiveness. Many reviews and commentaries have been published. Subsequently we have received regular editorial and reviews. A good example is a review by Bant Butterworth, attached, editor of the Robb Report's Home Entertainment magazine. He has now installed A-BUS in two of his homes. "Despite resistance in some areas Russound's



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introduction did attract ... Part of this systems magic is that it does not require racks of amplifiers and switchers. The keypad's contain amplifiers and the hub - the "brain" of the system - is its tiny box that connects to the keypads through a single CAT5... I missed my first A-BUS system terribly when I recently moved, and I am so thankful to have the new one installed. I have tested more than 500 electronics products in my career, including astoundingly good speakers, amplifiers and surround-sound processors. No other, though has brought me as much joy...".

15. A-BUS products manufactured by licensees in the US have now received most awards presented in the industry by industry associations and magazines. The attached brochure, entitled "The Easy Way To Multi-Room Audio", shows some awards for A-BUS.

16. A-BUS has now developed into an industry wide format with manufacturers from all areas of the industry adopting it. Companies such as Harman/Kardon and Onkyo Integra now have A-BUS/ready output sockets on their amplifiers. The A-BUS sockets on the back of their amplifiers replace the traditional Speakers 'B' facility with the flexibility of built in remote control and the same RJ-45 socket can interface with any A-BUS hub to expand the connection to as many rooms as required without effecting the main speakers. See the attached article from the January/February 2003 issue of Custom/Retailer, entitled "Is the A-Bus Going Your Way?".

17. A newer market sector, the structured wiring market, is providing a much needed service to the new home market organizing the many technologies being installed into homes these days. Telephone, video, data and now audio distribution are often centralized into one panel. In 2004 it is expected that 60% of new homes will have structured wiring panels installed. A-BUS has now become an industry standard in this market with most suppliers of structured wiring panels offering an A-BUS audio solution. Here again A-BUS simplicity and the use of category 5 cable is important. Installers are required to be proficient in a number of technologies (telephone, data, video, security, etc.). A-BUS uses the same cable they use in

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other technologies, the quality of sound is not affected by the longer cable runs needed for structured wiring and it is easy to design and install a high quality distributed audio system without necessarily requiring an audio engineer.

18. To date we have held back the introduction of A-BUS/direct our speaker technology where the power module is fitted directly onto the speaker/s. It is now in the process of introduction and we expect that five companies will introduce this technology in 2005.

19. Currently LeisureTech has signed over 30 Non Disclosure Agreements with companies interested in A-BUS technology. 15 of these companies are now shipping A-BUS product with several more working to introduce product in 2005. Some of these companies are major companies some are small, most importantly they represent all areas of the industry which is a good indication that A-BUS is now an accepted format in the audio industry and is an original and inventive technology. The current list of A-BUS licensees includes the following corporations: Russound FMP Inc.; Harman International Industries Inc; Onkyo Japan Corporation; OnQ Technologies Inc.; Channel Vision; Audio partnership plc; FutureSmart; Honeywell Security Division; United Speakers, US Tech; Home Director Inc; Tyco Electronics Corporation; and Jamo A/S.

20. A-BUS Sales Revenue. The following figures represent the approximate aggregate of sales revenues in US\$ of A-BUS (stand alone) and A-BUS (enhanced/ ready/ capable) product sold in the United States market place either manufactured by A-BUS Licensees or sold direct into the US market by LeisureTech Electronics Pty Ltd for the years ended 30 June 2000, 2001, 2002, 2003, 2004.

Year end date	Revenues
06/30/00	\$0
06/30/01	>\$1,000,000

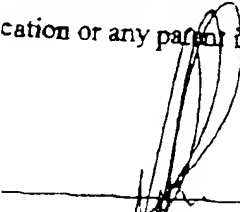
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06/30/02	>\$3,000,000
06/30/03	>\$37,000,000
06/30/04	>\$47,000,000

20. Finally, it is important to note that, no-one had come up with our concept before its release in the US and it was some time before there emerged some "A-BUS-like products" on the market. The impact on the market cannot be underestimated and demonstrates that this distributed audio technology is original and inventive.

All statements which I have made in this Declaration of my own knowledge are true, and all statements which I have made in this Declaration on information and belief are believed to be true. I have also been warned that willful false statements and the like are punishable by fine or imprisonment, or both under §1001 of Title 18 of the United States Code and may jeopardize the validity of this application or any patent issuing thereon.

Date: 26-Nov-2004  
\_\_\_\_\_  
Andrew Goldfinch

# A-BUS



## **Multi-Room Audio**

Simple Solutions. Create Big Markets

# A-BUS



## **Multi-Room Audio**

Simple Solutions, Create Big Markets

# A-BUS TECHNOLOGY

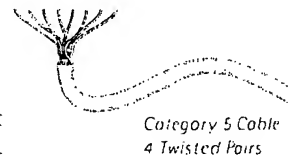
## The Story Behind A-BUS

A-BUS was developed by Australia's leading supplier of multi-room audio products, LeisureTech Electronics. With 35 years experience in the industry they found the traditional methods of audio distribution were fundamentally wrong - long lengths of speaker wire from a central amplifier to speakers far away just didn't make sense. The resultant solution is their patent-pending A-BUS technology, which is fast, becoming the industry format for the future of Distributed Audio.



## What is A-BUS

A-BUS is a simple solution for Multi-Room Audio that uses a single Category 5 cable to carry audio signal, infrared data, system power and system status to a power module in each room. High quality audio is delivered to each room without signal loss and each pair of speakers has their own individual amplification with independent volume up and down. It is simple to install and use. A-BUS has already been adopted by manufacturers in most sectors of the audio market and it is already a standard platform for Audio Distribution in Structured Wiring for new homes.



Category 5 Cable  
4 Twisted Pairs

## Why is A-BUS Special

A-BUS has more than achieved the all goals set by its developers and as a result has become a very powerful industry standard. This A-BUS standard is seen as the catalyst to the transformation of the multi-room audio market from a specialist market to a consumer market which is likely to become one of the industries biggest growth areas in the next decade.

## What is the Value of A-BUS as the Industry Standard?

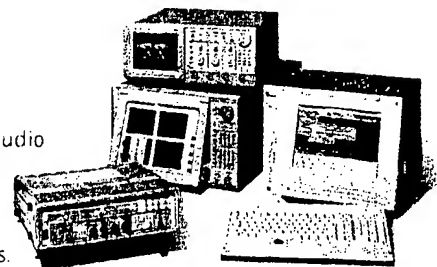
Manufacturers from all areas of the audio market can expect real compatibility in multi-room audio. This gives consumers a clearer message and the entire industry benefits - builders, developers, dealers and installers. The simplicity of A-BUS enables quick access to the rapidly developing markets in the home building industry.



The A-BUS trademark is another valuable asset. All A-BUS - approved products carry the A-BUS logo. Consumers know that equipment bearing the A-BUS logo is multi-room capable. They also know it will be instantly compatible with any other A-BUS product and sound great.

## Doing Business with A-BUS

Leisuretech Electronics is fully equipped to supply manufacturers with OEM A-BUS components providing fast and easy access to the growing market for multi-room audio with proven products. Under close supervision from LEISURETECH'S new facility in Sydney Australia, all products are manufactured to our strict QC standards and Bill of Material requirements. The new Leisuretech facility is fully equipped with R & D, Engineering, Testing, Quality Control and Marketing Support capabilities.



## A-BUS Standards

All A-BUS licensed products must comply with LeisureTech's published Product Standards. All manufacturers wishing to sell products bearing the A-BUS logo must submit their products for approval prior to their introduction.

# A-BUS - The Solution

The Solution when simplicity and functionality matters.

Consumers and suppliers are looking for uncomplicated multi-room audio. A-BUS technology removes confusion from the equation, creating fewer obstacles, more benefits, dependable performance and a profitable business structure. A-BUS opens the door for Distributed Audio to grow from a specialist business to a broad-based consumer business.



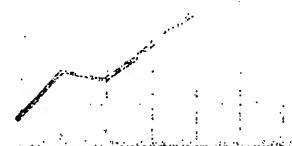
## Favorable Lifestyle Conditions

Today's consumer wants home entertainment in more than just one room – kitchens, bedrooms, studies, workshops and bathrooms are now essential entertainment areas too. They don't want ugly black boxes and messy cables to interfere with their decor. They do want an integrated, invisible solution that is simple and easy for everyone in the household to use.

A-BUS also helps out where space for the home theater system is often limited. A-BUS Distributed Audio can be simply an RJ-45 socket on the wall. In structured wiring panels, A-BUS hubs are compact and functional and the number of zones is expandable via the 4-way hubs' expansion ports. Combined with A-BUS/ready amplifiers, it is simply expandable by adding additional hubs and power supplies.

## Category 5-based A-BUS Opens the Door

A-BUS' use of Category 5 cable is ideal for Structured Wiring because it is familiar to everyone and inexpensive. It makes it easier for installers from other disciplines to be easily trained for A-BUS installation. The lower cost of wiring for A-BUS means more rooms will be wired for audio – creating homes with higher perceived value and more business opportunities for distributed audio systems.



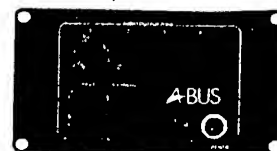
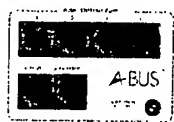
## A-BUS - structured wiring - the Gateway to the future.

Structured Wiring is the much needed solution to the growing consumer demand for homes that can provide a better lifestyle. Along with the demand for better phone systems, broadband access, security, lighting and system integration comes the desire to have multi-room audio. To provide these solutions economically, manufacturers in each field have had to create packaged products that are easy to specify and that can be reliably installed by local installers. A-BUS simplicity fulfills all these requirements, and as a result, it has been quickly adopted by most structured wiring manufacturers.

The question is – what is the market potential for audio in this environment? Recent studies show custom-installed audio in new homes to be about 10% while structured wiring panels have come from under 5% percent 5 years ago to an expected 50% in 2004.

In 2004, products will be shipped by at least seven leading brands in the Structured Wiring industry. Their commitment to A-BUS has created an industry standard for audio distribution that gives builders, system designers, installers and new home owners clear wiring guidelines for their audio requirements. It all adds up to a prescription for healthy sales growth for multi-room audio and A-BUS. A-BUS will enable the custom market to develop even greater potential.

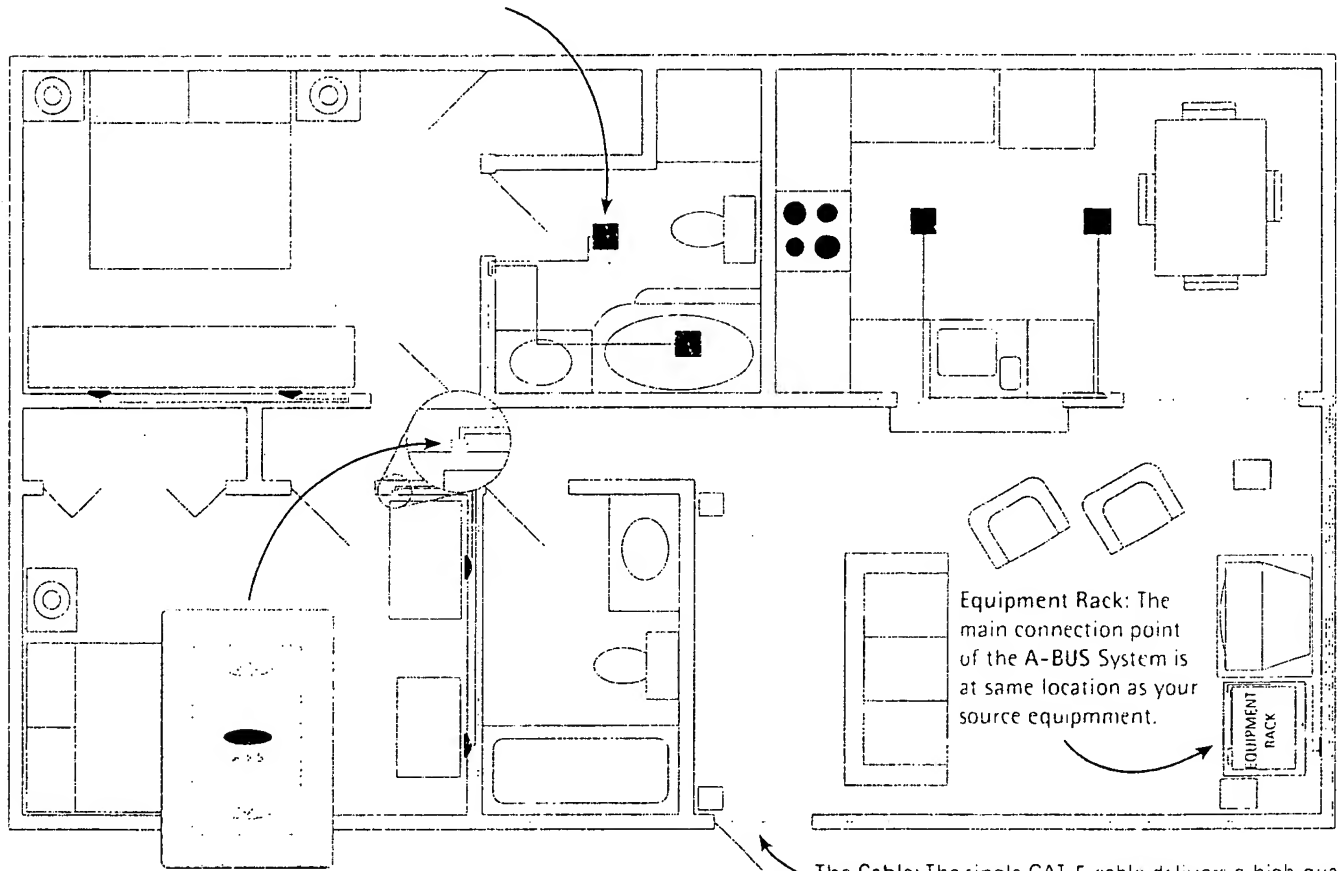
A-BUS offers a variety of distribution hubs ideal for the Structured Wiring industry.



# What Makes Up an A-BUS System?

The following diagram explains the typical structure and key components that make up an A-BUS system:

**Speakers:** The system will work with any normal in-wall/ceiling and traditional box loudspeakers. However, the in-wall or in-ceiling variety is recommended – with a sensitivity rating of 88 dB or better and an impedance between 4 and 8 ohms.

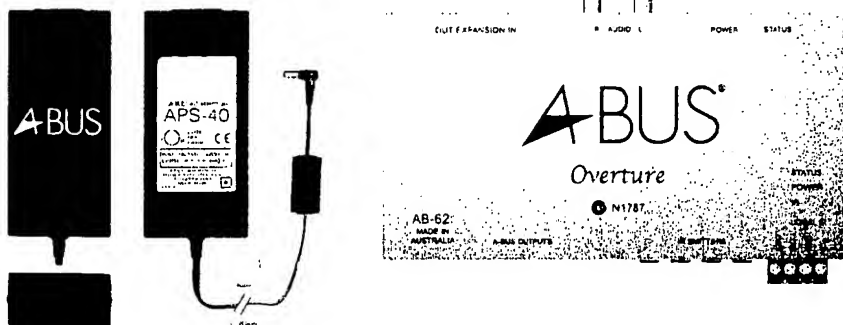


**The A-BUS Module:** The A-BUS module is in place of the traditional volume control (attenuator) with a power module (amplifier). The size is similar, and fits into a standard single-gang electrical switch housing (J-Box). An A-BUS power module may also be connected directly to the speakers.

**The Cable:** The single CAT-5 cable delivers a high quality audio signal without losing signal quality. It supplies system power that is centralized while also supplying data (infrared commands) and system status.

## At the equipment rack - the hub

**The Hub:** At the core of the system is the A-BUS hub, located near the main system amplifier or in a structured wiring panel to distribute audio signal, system power (power supply) and status to each power module. Custom hubs also distribute infrared data to the source components. In structured wiring environments, if the amplifier is not A-BUS/ready, an Interface Module is required near the amplifier for audio source input and for infrared data output. Hubs generally distribute to four zones and multiple hubs may be used. They can be either single source or multi-source.



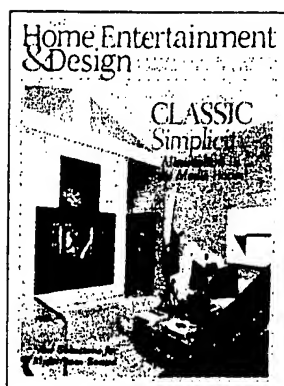


# What sets A-BUS apart?

It is easier to see the uniqueness of the A-BUS and appreciate its simplicity with a quick overview of where current systems fall short along with the obstacles to success that existed prior to A-BUS.

Area	Issue	How A-BUS solves it
Wiring	Speaker level signal distribution degrades signal quality and reduces power output	Distributing the signal at line level eliminates loss and improves sound quality
	Complex wiring requirements costs more to install	A-BUS uses one single CAT-5 cable that is easy to install and is lower in cost
	Separate cable required for Infrared data in addition to audio cable	The cable transmits audio signal, system power, infrared data and status without the need for multiple wires
	Quality and weight of speaker cable limits the ultimate sound quality	One simple CAT-5 cable will deliver consistently high performance to all locations
	Inefficient impedance matching required for single amplifier applications	Line level signal distribution eliminates this problem
Amplification	Central amplifier volume control affects sound level in every room	Main amplifier volume does not affect the volume control of the remote rooms
	Volume controls in remote rooms are stepped (6-12 steps) Therefore they can only reduce volume-not increase it!	A-BUS lets the user adjust volume both UP and DOWN (infinite adjustment possible)
Functionality	Music source often limited in remote rooms	A-BUS incorporates the flexibility to select a number of sources as well as the number of locations covered
Installation	Complex system designs requires advanced designers and engineers	Use of a single cable wiring system in a star pattern makes A-BUS easy to install and is also "future-proof"
	Upgrading system to multi-source etc. is difficult and expensive	A-BUS modules are all inter-compatible making upgrades a simple process at any time

Bottom Line - A-BUS eliminates all traditional multi-room problems. It also eliminates the signal losses that have often been overlooked. As a result, A-BUS delivers a high quality audio signal to every room. The power output (deliberately never quoted) is the system's biggest surprise. It delivers enough power for 99% of multi-room applications. In situations where very high power output is required a local power amplifier can be easily adapted, using standard A-BUS wiring.



HOME ENTERTAINMENT & DESIGN, Summer 2003

Article by Brent Butterworth - Editor

*"This system is magic."*

Brent said "I am heartened to see whole house audio systems in so many luxury homes. Yet I notice some of those systems go largely unused". Brent's reasoning "any device more complicated than a toaster will frighten away nine-tenths of all people. Simplicity, when it comes to multi-room audio, is a vital factor. A-BUS is simplicity." Brent continues, "The logical extension of my theory is that whole-house audio systems should be as simple to operate as a toaster..."

In Brent's overview, "...it will be one of the most useful home improvements you can make because you will use it every day." Brent's summarizes, "I have tested more than 500 electronics products in my career, including astoundingly good speakers, amplifiers and surround-sound processors. No other, though, has brought me as much joy as this one."

# A-BUS Applications and Opportunities

A-BUS is an industry format that is available to manufacturers from all market sectors. LEISURETECH has a wide range of complementary products that readily integrate their individual multi-room audio products into a compatible standard. The A-BUS standard ensures compatibility. The A-BUS logo ensures consumer confidence.

The A-BUS technology platform can be applied to meet your marketing opportunities in many ways. Constant in any application is that fact that A-BUS always sounds great. Here are some of the A-BUS applications available to you.

## A-BUS /custom

A-BUS/*custom* products are targeted to the specialist market. Custom products are stand-alone products that can be integrated into a wide variety of applications, from standard components for basic systems to sophisticated components which can provide added facilities and flexibility. The A-BUS/*custom* market is increasingly well established and has high growth potential. These products suit organizations involved in the custom audio market, as well as those looking to enter. The manufacturing of the components is easy and does not require expensive tooling.

## A-BUS /structured

A-BUS has been recognized by the Structured Wiring industry as an excellent solution to their Distributed Audio needs as described in detail in other sections of this brochure. A-BUS distribution hubs can be readily adapted to fit specific Structured Wiring panel dimensions and functionality can be designed to meet specific needs. A-BUS provides a neat, simple solution that integrates beautifully with the rest of the Structured Wiring industry. The building industry sees A-BUS/*structured* as an excellent tool to get multi-room audio into more homes, increasing the perceived value and attracting more buyers.

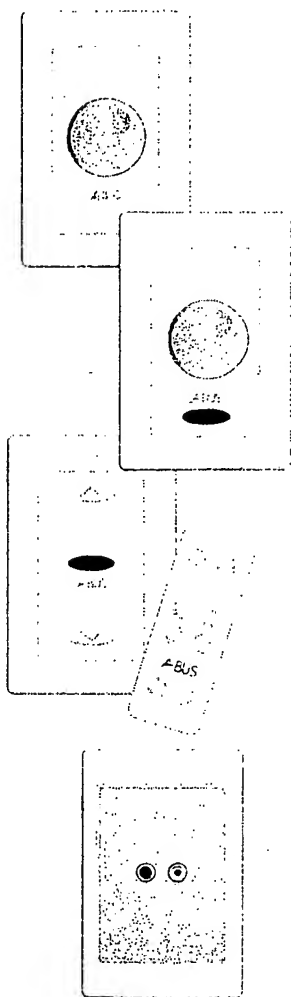
## A-BUS /direct, A-BUS /active

Installing the power module directly on the loudspeakers opens up many new and exciting opportunities and advantages.

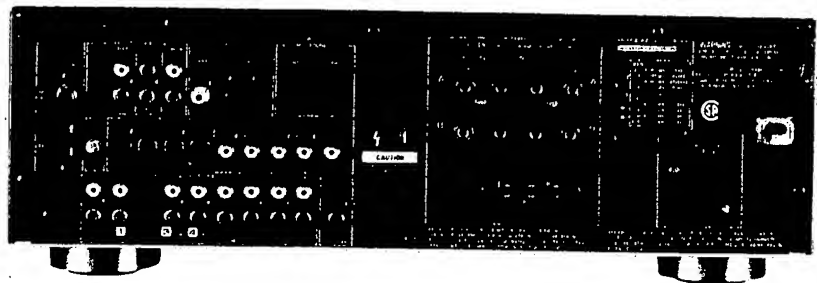
Running the Category 5 cable directly to the speakers completely eliminates the weakest link in the system, the speaker cable itself. Many new opportunities are opened up for speaker designers. Drivers and crossovers can be specifically designed providing for better efficiency and sound quality. The direct wiring can simplify the installation process and make retrofit installations easier than ever.

A-BUS/*direct* is a cost-effective solution where the power module is mounted on the back of the master speaker and includes the infrared receiver to receive control data. A-BUS/*direct* is the ideal solution for owners of A-BUS/*ready* amplifiers who wish to expand their system to an additional room. Only one Category 5 cable is needed between the speakers and the amplifier!

A-BUS/*active* is an opportunity for performance based speaker manufacturers to develop loudspeakers with the sophistication that reflects their product quality and to achieve audiophile performance from "In Wall/Ceiling" loudspeakers. These companies will also be able to take advantage of the large number of new homes being pre-wired for A-BUS. A limited number of licenses will be issued for this technology.



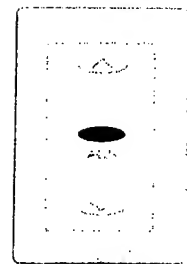
# A-BUS



## A-BUS ready

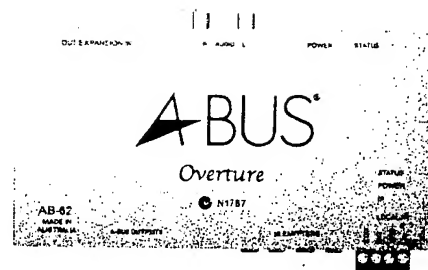
For many years A/B speaker selection has been a standard feature on components. **A-BUS/ready** is the catalyst for that to improve. Today's consumers want their receiver to be an entertainment source for the whole house. Distributed Audio is growing strongly and manufacturers need easy access to this growing market. **A-BUS/ready** implements easily, adds great value, and creates a house full of new selling opportunities.

**A-BUS/ready** is ideal for mainstream Hi-Fi manufacturers - by simply placing an RJ-45 socket on the back of amplifiers, and Hi-Fi Systems. The one socket handles all requirements - from a simple one room extension from Speakers 'B' to providing direct connection to the growing range of A-BUS components to suit nearly any application.



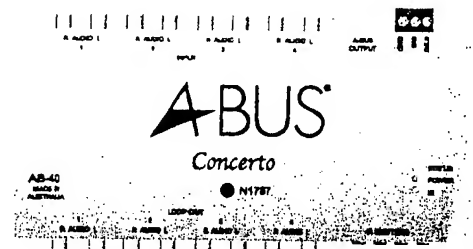
**A-BUS/ready** is a simple solution that gives consumers a variety of multi-room audio solutions.

**A-BUS/ready** and Speakers 'B' - Simply one cable extends the sound system to another room. Connection to any A-BUS power module gives individual volume up and down and full infrared remote control. **A-BUS/ready** is the smart way to replace Speakers B and makes great economic sense. The savings on the cost of parts associated with Speakers B and/or the volume control chip in a second zone output help offset the parts cost for adding **A-BUS/ready**. As the consumer awareness of A-BUS grows, the consumer value of **A-BUS/ready** increases. And at the same time, the low cost and engineering simplicity of **A-BUS/ready** surprises most engineers. **A-BUS/ready** is like all other A-BUS formats - providing a simple solution that does its job extremely well.



**A-BUS/ready** and Full custom audio - The same RJ-45 socket is also compatible with any A-BUS hub - providing access to any number of additional rooms.

**A-BUS/ready** and Structured Wiring - With one Category 5 cable the same RJ-45 output will provide simple and space efficient integration to the growing number of homes with structured wiring systems that include A-BUS pre-wiring.



**Safety Note:** **A-BUS/ready** is IP safe. This means that no damage will occur, even if A-BUS is accidentally connected to an Ethernet jack.

## **A-BUS, the format of the future**

A-BUS is the key to new growth opportunities for the future.

Consider the integration of the three A-BUS technologies.

**A-BUS/ready** amplifiers can power one or two extra rooms directly.

A single Category-5 cable from the back of the amplifier to each

room to connect to either an A-BUS/custom wall module or

directly to an A-BUS Active in-wall speaker. For larger multi-room

installations an **A-BUS/ready** amplifier can be connected to an

A-BUS connecting block to suit most applications. A-BUS is a

simple way to "plug and play."

# Industry and Consumer Acceptance

Every one loves A-BUS - A-BUS has built a strong brand position and a positive reputation for dependability and quality. Reviewers love A-BUS. Installers like its simplicity and dependability. Dealers enjoy the design flexibility and value. Everyone is surprised that such a simple technology can deliver so much performance. A-BUS is a trouble-free format that is easy to design and install that takes the complication out of distributed audio.

## Why Everyone Loves A-BUS

A-BUS has an unusual position in the market. Everyone loves it and there are good reasons why.

### Simplicity.

A-BUS makes multi-room audio easy for everyone manufacturers, system designers installers and consumers.

### Sound quality.

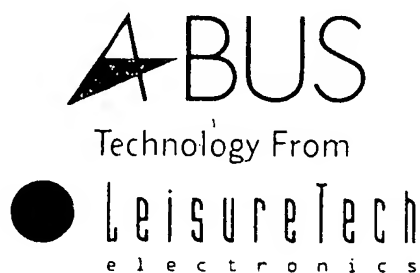
Yes, "have you heard it" is the real question, how can a technology so simple sound so good. Well the answer is just as simple. A-BUS eliminates the losses found in traditional distributed audio systems. With A-BUS you can be confident of a good result every time.

### Flexibility.

When a home is pre-wired for A-BUS the new home owner can start with a simple system and have the opportunity to upgrade and expand the system in the future.

### Compatible.

With the A-BUS standard consumers know that any product bearing the A-BUS logo is A-BUS compatible with all other A-BUS products. It makes the choice of product quite simple.



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# MUSIC BY MAGIC

AN UPGRADE LIFTS RUSSOUND'S A-BUS MULTIROOM AUDIO SYSTEM FROM SIMPLE TO SENSATIONAL.

BY BRENT BUTTERWORTH PHOTOGRAPHY BY JOHN PHILLIP

**A**s a music lover, I am heartened to see whole-house audio systems in so many luxury homes. Yet I notice that some of those systems go largely unused. Why would anyone ignore a system that spreads music to every room of the house? I have a two-part theory. Part one: Most whole-house audio systems are controlled by wall-mounted keypads that cram eight to umpteen buttons into a space the size of a business card. Part two: Any device more complicated than a toaster will frighten away nine-tenths of all people.

The logical extension of my theory is that whole-house audio systems should be as simple to operate as toaster and Russound has done just that with its A-BUS multiroom audio system.

With the A-BUS system, you see only a keypad with three buttons. When guests notice the keypads on my walls and ask what they do, I tell them, "Punch a button and find out." In seconds, music envelops them.

The original Russound A-BUS system was perhaps

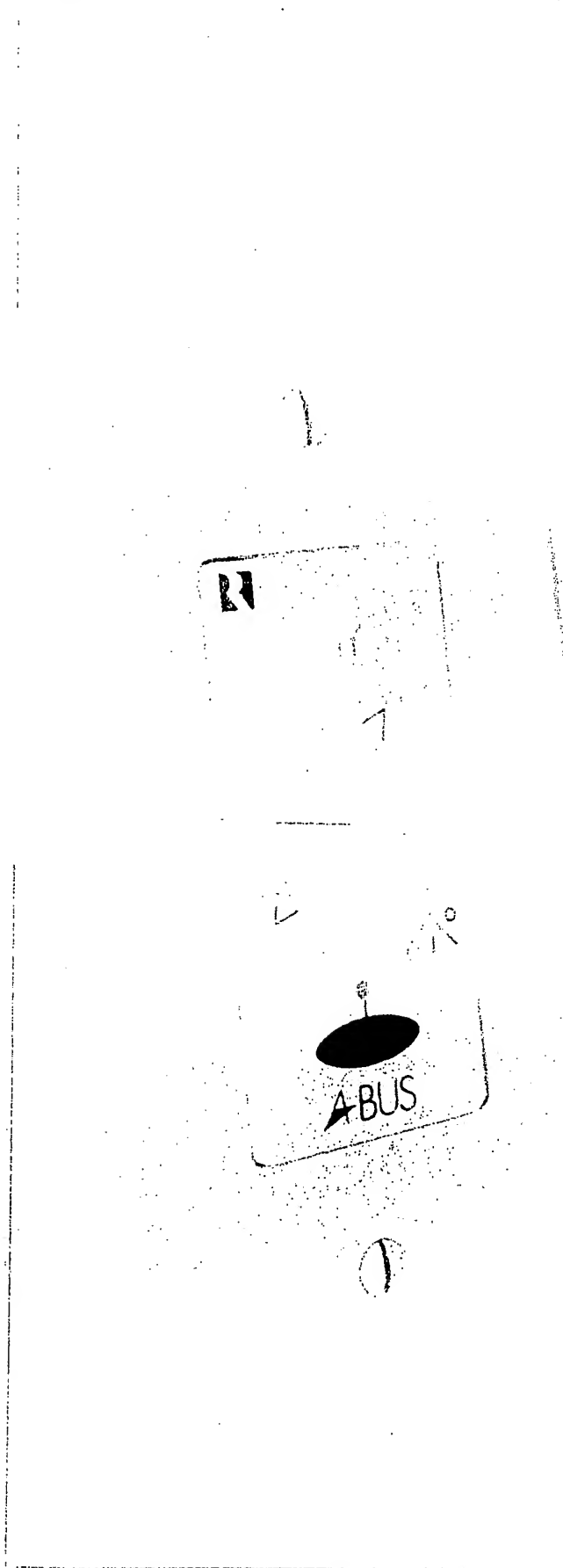
too simple. Through the keypad, it accessed only a single audio source, such as a CD player or AM/FM radio. One source is simply not enough. Who among us does not want to spice his or her CD listening with an occasional baseball game on AM radio (or vice versa)?

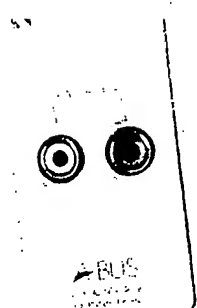
Russound's revised A-BUS system solves that problem without adding a single button. The old version offers buttons for on/off, volume up and volume down. With the new version, pushing the on/off button now cycles among up to four audio sources.

Holding this button down for a couple of seconds shuts off the sound for that specific room. Pressing the button again shuts off the sound in every room.

You have just read everything you need to know about operating the Russound A-BUS system.

A handheld remote controls the A-BUS system and all of the audio source devices connected to it; the remote will work in any room that contains a keypad. With this remote, I anxiously await the moment when my guests turn up their noses at my music





*The A-IC2 input module (left) lets your installer add an extra CD player or other audio source device for any room. The tiny A-H484 hub (below) and its power supply are all the electronics the A-BUS system needs.*

selection, I simply pick up the remote, press a button to change the CD selection, and revel as they look around in search of my audio components, which are hidden in a service closet several rooms away.

The A-IC2 accessory lets your installer add an extra CD player or other audio source device to any A-BUS-equipped room. It provides a stereo audio input and fits a Decora switchplate. You can use A-IC2s to add CD players in the guest bedroom and your kids' rooms so they can easily play music of their choosing; I use one to hook up a record player in my lounge. When the source connected to the A-IC2 begins playing, the keypad in that room automatically switches to that source.

While A-BUS is primitive compared with most multiroom audio systems, I find ways around its limitations. I regularly listen to three radio stations: two FM and one AM. With most multiroom systems, I can switch stations from the keypad. Obviously, I cannot accomplish this from the Russound system's three-button keypads. However, a solution comes to mind: I connect three radio

timers, set each one to a different favorite station, then use the on/off buttons on the keypads to select the different timers. Presto—my favorite radio stations are now at my fingertips.

A computer also mates well with the Russound A-BUS system if you set the computer up for wireless control from a Pocket PC (see this month's "Editor's Note"). With the Pocket PC, I can select the music I want to hear from anywhere in my home, and the Russound A-BUS system lets me distribute music from the computer to each room.

Part of this system's magic is that it does not require racks of amplifiers and switchers. The keypads contain the amplifiers, and the hub—the "brain" of the system—is a tiny box that connects to the keypads through a single Cat-5 cable. A small AC adapter connects to the hub to provide power for the keypads.

The basic A-BUS kit supplies sound for up to four rooms, each with its own keypad. The A-H484 hub Russound supplies in the kit accommodates up to four more keypads (for a total of eight) with the addition of a second power supply. By adding more

hubs and more power supplies, your installer can expand the system to suit even large homes.

The significant limitation of A-BUS, however, is power—each keypad supplies only 7.5 watts per channel. You might be surprised, though, to discover how far 7.5 watts can go, because casual music listening normally consumes only a watt or two of power. I find the power adequate for every application save two: driving a set of rock-shaped speakers in my backyard and cranking up all of the keypads in the house for a party. It is easy, though, to add more power where you need it. Each keypad has terminals that allow your installer to connect a more powerful amplifier, or to add a subwoofer to augment the bass in any room that needs the additional oomph.

Certainly, some homeowners will demand the superior sound quality and flexibility of high-end multiroom systems, and some will want to access more than four audio sources for multiroom sound. But if you can live with this system's limita-

tions, it will be one of the most useful home improvements you can make because you will use it every day. I missed my first A-BUS system terribly when I recently moved, and am so thankful to have the new one installed. I have tested more than 500 electronics products in my career, including astoundingly good speakers, amplifiers and surround-sound processors. No other, though, has brought me as much joy as this one. **RECOMMENDED**

#### DESCRIPTION

Four-room/four-zone multiroom audio system, including power supply, two two four keypads. Requires Cat 5 cabling, speakers and separate audio sources.

#### CONNECTIONS

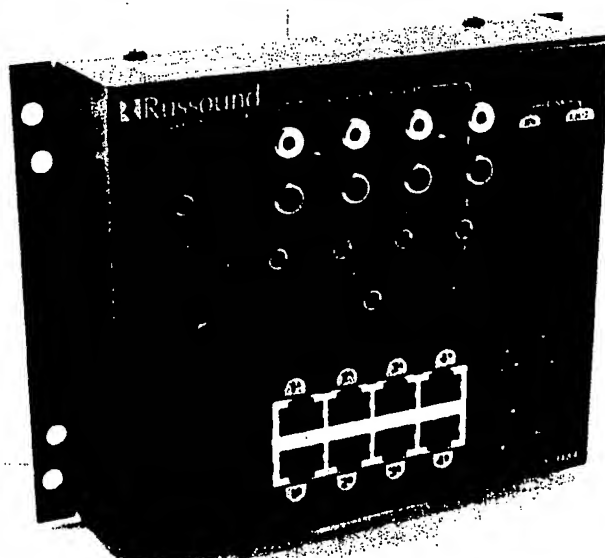
A-H484 hub, four analog stereo audio inputs, two 3.5mm composite video, for IR remote control receivers, eight RJ-45 keypad connections, power supply input. A-EF2 keypad, eight conductor push-on wire connector for Cat 5 cable, block connectors for stereo speakers and pre-amp output.

#### DIMENSIONS

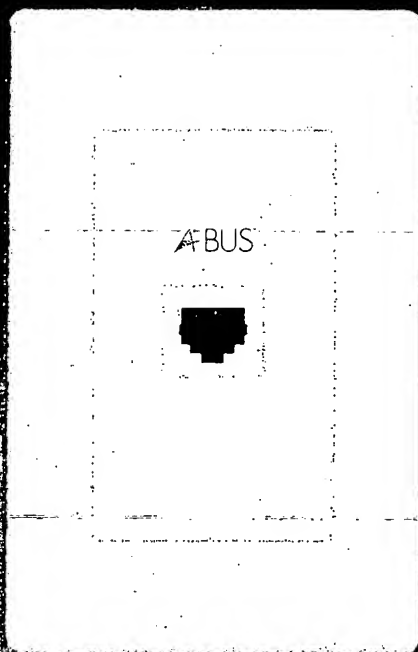
A-H484 hub: 1.5 x 0.4 x 1.5 inches (heavy). A-EF2 keypad: 2.6 x 1.2 inches (fits Decora switchplate).

#### PRICE/CONTACT

**PRICE:** \$1,499 for basic kit (four keypads, one A-H484 hub, one power supply, one universal remote control, one A-IC2 input module and accessories), plus installation. **CONTACT:** (800) 658-5170, [www.russound.com](http://www.russound.com).



THE  
EASY WAY TO  
MULTI-ROOM AUDIO



A-BUS™

# A-BUS HAVE YOU HEARD IT?

## Letter from Andrew

Andrew Goldfinch, co-creator of A-BUS™



Many people have asked me how we developed A-BUS™. To answer to that would take a long time, but the simple answer is we wanted to get the basics right.

Technically, we knew long runs of speaker cable through a home was not right. Everyone knows the amplifier should always be as close as possible to the speakers.

Being able to do everything in one cable was a key requirement, but that one cable being a category 5 cable was a bonus which we did not expect.

It is also important to have a good understanding of your market and what the consumer really wants. Too often we find manufacturers designing products around their technology and not around the consumers needs.

They also want everything to vanish, no messy wires and no ugly boxes, otherwise they would save a lot of money and put a midi system in every room.

The real success of A-BUS™ is the advantages a one cable solution offers to everyone, from builders and architects, to systems designers to consumers. If you look at A-BUS™ in these terms you will see that it is a very powerful solution.

Too often we find manufacturers designing products around their technology and not around the consumers needs.

Audiophiles want to provide thundering power in every room and system integrators want to provide a million features, but most people do not want sophisticated or complicated solutions in kitchens, bedrooms and bathrooms. Consumers want simplicity and functionality.

**"The real success of A-BUS™ is the advantages a one cable solution offers to everyone..."**

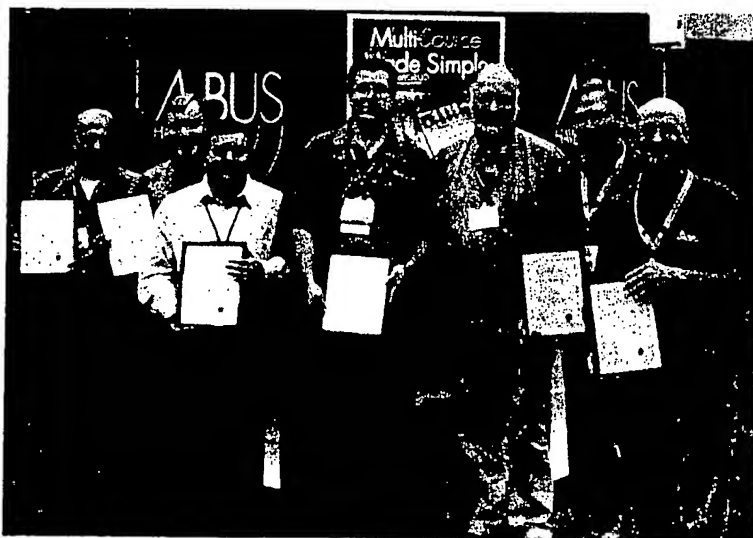
## Progress of A-BUS

No matter how you define the word 'standard', A-BUS™ has been accepted as a standard format for the multi-room audio market with manufacturers from all sectors adapting the A-BUS™ format created by LeisureTech Electronics, Sydney Australia. A-BUS™ technology is based upon the unique ability to transmit stereo audio, infrared data, system power and status down a single Category 5 cable.

A-BUS™ is now clearly being seen as an industry format for distributed audio. Its simplicity has advantages for everyone; manufacturers, system designers, installers and consumers.

Its flexibility, high quality sound and low cost makes A-BUS™ the foundation stone for market growth. A-BUS™ technology is available by license only and all partners are required to comply to A-BUS™ standards to ensure compatibility between all products bearing the A-BUS™

trademark. For further information regarding A-BUS™ licenses please contact Andrew Goldfinch at:



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# A-BUS<sup>TM</sup>

## INSTANT ACCESS TO MULTI-ROOM AUDIO

### A-BUS<sup>ready</sup><sup>™</sup>

A-BUS<sup>TM</sup> offers advantages to every market sector in distributed audio. To electronics manufacturers A-BUS/ready<sup>TM</sup> means instant access to distributed audio, the advantages are significant.

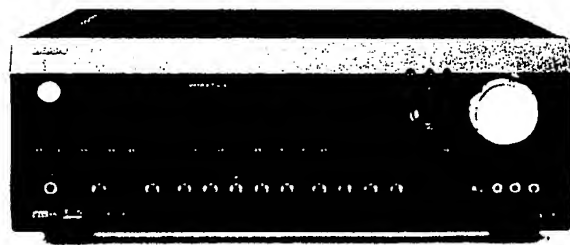
#### A-BUS<sup>TM</sup> - A Standard for Future Growth

LeisureTech is working with the industry to not only create a format that is simple for everyone to adopt but a standard that will allow all manufacturers products to interconnect to provide maximum flexibility to consumers. The A-BUS<sup>TM</sup> "plug and play" approach will provide a strong foundation for custom audio market to grow into a broader consumer market.

#### A-BUS/ready<sup>TM</sup> - To 'B' or not to 'B'

A-BUS<sup>TM</sup> is the 21st century replacement for the 'B' speaker outlet on amplifiers. The traditional 'B' speaker outlet no longer provides a real benefit to consumers. In a secondary room remote control is vital and because most amplifiers only have a toggle button for ON/OFF the operator needs to know if the amplifiers status is on. Secondary speakers often place difficult loads on amplifiers and systems with long cable runs and volume controls connected reducing overall system sound quality. A-BUS<sup>TM</sup> is the new way to 'B'.

**"The A-BUS<sup>TM</sup> trademark is fast becoming one of the most noticed names in the distributed audio market"**



Integra DTR 6.3 - 6.1 Channel A-BUS/ready Home Theater Receiver

#### The A-BUS<sup>TM</sup> Trademark

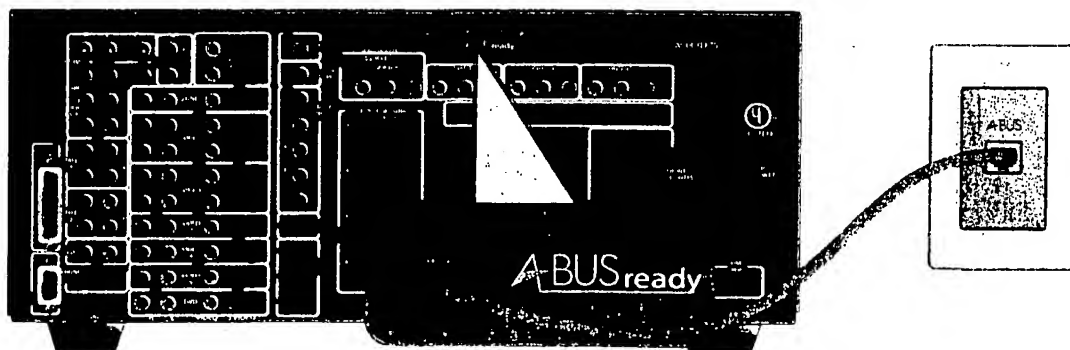
The A-BUS<sup>TM</sup> trademark is fast becoming one of the most noticed names in the distributed audio market. All A-BUS<sup>TM</sup> partners display the A-BUS<sup>TM</sup> logo on their A-BUS<sup>TM</sup> products. A-BUS<sup>TM</sup> products have been receiving regular awards and A-BUS<sup>TM</sup> is receiving regular comment in the trade press. A-BUS<sup>TM</sup> is seen as the distributed audio standard of the future.

#### A-BUS/ready<sup>TM</sup> Offers Flexibility

A-BUS<sup>TM</sup> can simply be one RJ-45 socket delivering audio and status out and IR data in. Options can include system power in the output. The output can be the single zone on basic models and second zone on premium models. Future options may be to provide individual source selection for multiple outputs.

#### A-BUS/ready<sup>TM</sup> is Easy to Install

The cost to equip an A-BUS/ready<sup>TM</sup> amplifier is easy. Little modification is required. A simple A-BUS/ready<sup>TM</sup> outlet is an RJ-45 socket with stereo line level (with increased gain) and status (voltage trigger) out and IR data in. No proprietary parts are required. With all the requirements of today's modern amplifiers space on the back panels can be very tight. A-BUS<sup>TM</sup> can be as simple as a single RJ-45 socket.



# A-BUS STRUCTURED WIRING AND OEM

## A-BUS<sup>™</sup> in the Structured Wiring Market

A-BUS is set to make a big impact on the fast growing structured wiring industry. It is a fast growing market with a massive 50% of new homes in the US expected to incorporate a structured wiring panel by 2004. The simplicity of A-BUS creates many advantages for this dynamic market.

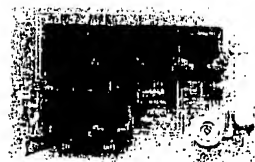
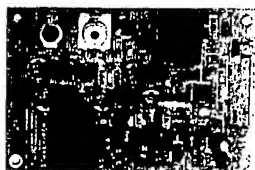
OnQ Technologies, a leading manufacturer in the home networking market, was the first company to integrate A-BUS technology as part of a home network system in January 2002. In January 2003 A-BUS products will also be shipped by AMP/Tyco, Channel Vision, Greyfox, Home Director and UStec. The commitment by these companies has made A-BUS an industry standard for audio distribution that gives builders, system designers, installers and new home owners clear wiring guidelines for their audio requirements.

A-BUS is ideal for use in the structured wiring community because it relies on category 5 cabling. The use of category 5 cabling also makes it easier for installers from other disciplines to be trained to install A-BUS audio distribution systems. Currently seven leading suppliers are training their installers to wire homes for A-BUS.

A-BUS is a BIG space saver. In the family area where space for the home theater system is often limited, A-BUS distributed audio is simply an RJ-45 socket on the wall. In the structured wiring panel the A-BUS hub(s) is/are also compact and functional. The number of zones is not limited at all since the 4-way distribution hubs include expansion ports for multiple hubs.

The lower cost of wiring for A-BUS means that more rooms will now be wired for audio creating homes with higher perceived value for the builder and a future asset for the audio industry.

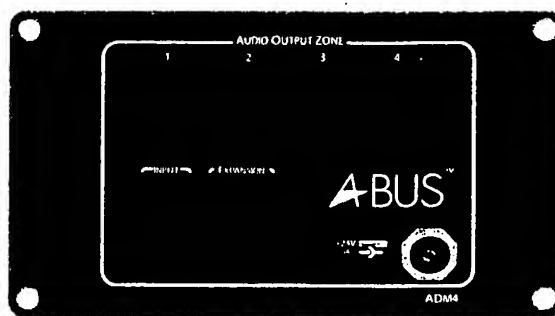
## OEM a fast and efficient service for manufacturers



In partnership with SCI international, a well known supplier of OEM audio components to US manufacturers based in Nashville Tennessee, LeisureTech is now offering A-BUS<sup>™</sup> OEM products to manufacturers.

With manufacturing in Asia, LeisureTech has been keen to ensure high quality A-BUS<sup>™</sup> products are made. This arrangement provides for production engineering, supervision and quality control from Australia, and design and technical support for clients provided in the US. Products can be warehoused in the US or shipped directly into store with the minimum of fuss.

For those who require special engineering and styling, assistance can be provided with competitive pricing on tooling, etc. SCI has extensive contacts in Asia to source a wide range of audio products for OEM supply.



A-BUS<sup>™</sup> Structured Wiring Panel Distribution Hub

**"The CAT-5 architecture is ideal for home networking application. It allows the system designer and the installer to work consistently with CAT-5 saving time, money and potential mistakes"**

- Doug Fikse, President  
- OnQ Technologies

# A-BUS

## AWARD WINNING PERFORMANCE



Year 2001 -

Russound A-BUS Multi-Room Distributed Audio System

Year 2002 -

Russound A-BUS A-H484 Multi-Source Hub

Year 2002 -

OnQ A-BUS Audio System

*Everyone loves  
A-BUS™*

*Even the girls...*



**Best Multi-Room Category -**

Russound A-BUS A-H484 Multi-Source

**Best overall Category -**

Russound A-BUS A-H484 Multi-Source

**Alternative Transmission Technology -**

OnQ Technologies A-BUS 4-Room Finish Kit

*A-BUS™ was  
included in the  
Girls Best Friend  
showcase  
at the 2003  
International CES*



Year 2002 -

Russound A-BUS System



Year 2002 -

Russound A-BUS System



Year 2002 -

Russound A-BUS System With Multi-Source (A-H484, A-KP, ALRC-1)

Year 2001 -

Russound A-BUS Multi-Room Distributed Audio System

*"The award winning  
A-BUS™ line by  
Russound represents  
state of the art in multi-  
room audio yet it is  
attractive, simple to  
use, affordable and  
sounds great."*

Year 2001 -

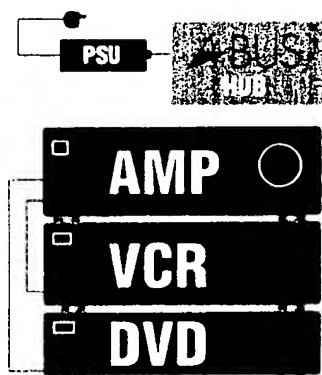
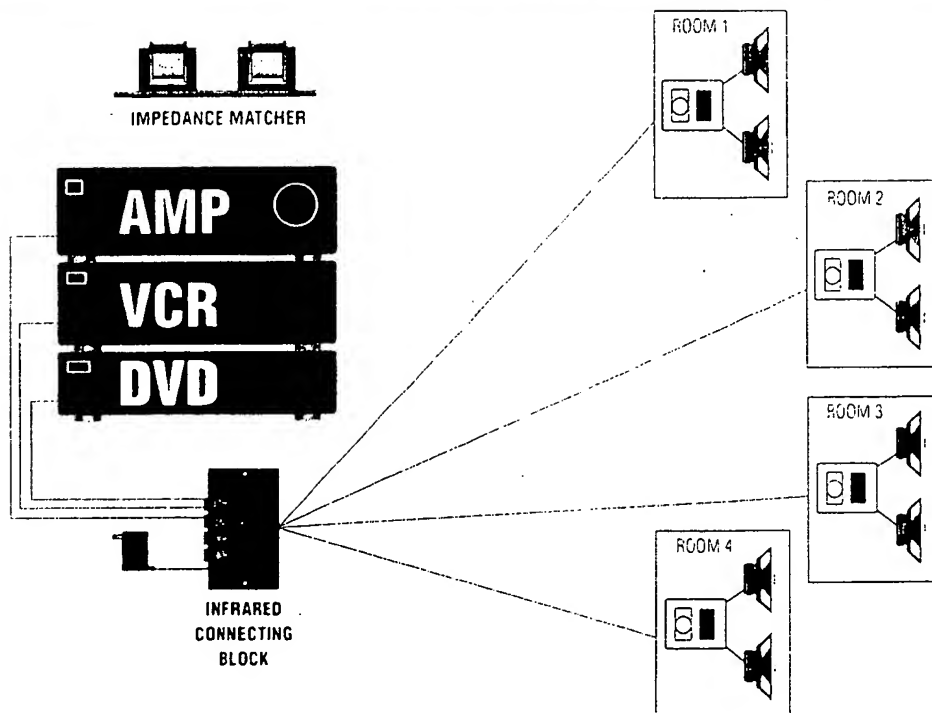
Russound A-BUS

Year 2002 -

OnQ - A-BUS System

## TRADITIONAL LIMITATIONS

- ▶ Degrades sound quality
- ▶ Volume levels in all rooms rely on the main amplifiers volume setting
- ▶ Volume can only be turned down (attenuated) in remote rooms
- ▶ Stepped level control, Requires impedance matching
- ▶ Separate Infrared system required
- ▶ No status
- ▶ System needs to be fully designed before installation
- ▶ Limited expansion



## A-BUS<sup>TM</sup> ADVANTAGES

- ▶ High quality audio
- ▶ Volume control can be individually adjusted (including the main room)
- ▶ Infinite volume adjustment
- ▶ One category 5 cable includes Infrared data and status
- ▶ Easy to design and install
- ▶ 1 to 100+ rooms
- ▶ Wiring allows for either single source or multi-source
- ▶ Upgradeable to future technologies
- ▶ Compact

# Is the ABus Going Your Way?

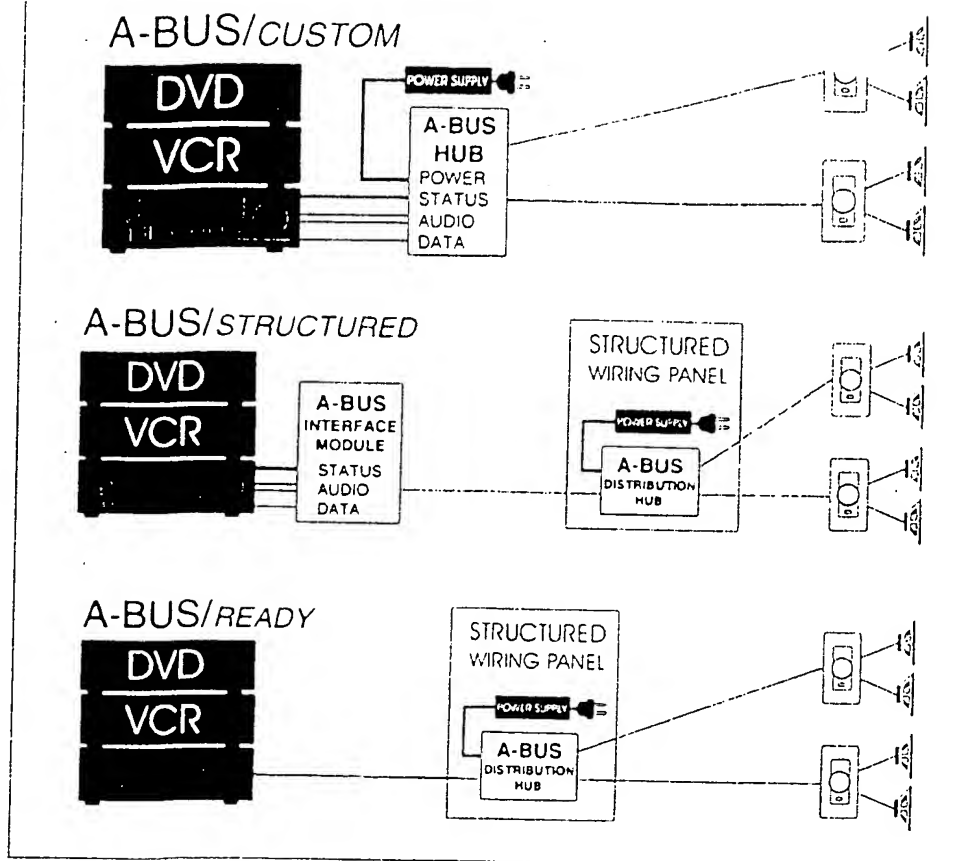
<BY RON GOLDBERG>

Anyone who either designs or markets technology products can tell you it isn't easy to go against an established order. In the case of Sydney-based Leisuretech Electronics, developer of the ABus audio distribution system, the challenge has been taken up on two fronts. ABus is not only a departure in terms of technology, but also a marketing challenge. How do you get system designers and C-tailors to go against a well-established, decades-old paradigm?

According to Andrew Goldfinch, president of Leisuretech, it's about offering a simpler product that can still claim to be a better mousetrap than the status quo. His company's ABus system, which is available both via established product lines and also as a licensable technology, is trying to change the way audio is carried around the house. Recent licensees are showing that the idea may be catching on. Says Goldfinch, "We see it not as a product, but as a platform. It makes the whole way you do distributed audio easier, with a better sound in the end."

A lofty claim, but one that's finding more adherents. Because it was first to market with ABus-enabled products, Russound is often perceived as "the ABus company." But the ABus technology's reach has been steadily increasing, with powerhouses like UStec, Home Director, ChannelVision and recent Leviton acquisition, OnQ, now offering ABus products. Recently, mass market audio vendors Harman Kardon and Onkyo began offering consumer-level home theater receivers with ABus capabilities. The radical idea that Goldfinch and Leisuretech Chief Engineer Len Andrews first came up with in 1991 is getting its moment onstage.

The basic concept behind ABus is to distribute audio as a line-level signal to the local zone for amplification, rather than speaker-level output from a centralized location. One CAT5 cable carries the audio, IR data, operating power and signal status from a what ABus calls a "Central Power Unit," which accepts signals from the traditional A/V source components. The CPU contains system connectivity and the amplifier's power supply, which is the biggest physical component of an audio amp.



In practice, this means that each of the local listening zones features amplification capabilities, or more accurately, parts thereof. In traditional audio amp design, whether it be stereo, multichannel or multi-zone, the power supply is what's taking up all the space. Outside of the power supply, the other components that comprise an audio amplifier are relatively small and simple to compartmentalize—even into something as small as a wall plate.

The benefits of the ABus "divide and conquer" approach are easy to see in theoretical terms, and in Goldfinch's opinion, to hear as well. The extensive speaker cable runs that extend from the central amplifier location in a typical custom installation become unnecessary. The attendant loss of quality through transformers, impedance matchers, power drop-off, capacitance and inductance is largely eliminated.

Says Goldfinch, "We're all custom installers ourselves. We started in the 1960s and saw the traditional way people were doing distributed audio, with attenuators, step devices, etc. The whole system ended up with loss. The ABus works off line level, the amp in the room doesn't affect the rest of the house. You get a good clean signal for every room in the house."

The ABus system can be configured for three different custom install situations. For situations where the entire implementation will be done with ABus,

the source components feed an ABus hub, which then distributes signal to the local zones and ABus controllers. For installations where the structured wiring is already in place, an ABus interface module carrying system status, audio and data is connected to the structured wiring panel, which would also include an ABus distribution hub. Finally, installations can be made "future-ready" for ABus capabilities. If a pre-wire job includes an ABus hub, current and future A/V equipment with ABus capabilities can simply plug in.

ABus may be meant to appeal to the installer market, but its various purveyors are clearly looking to the builder community to help out with the evangelizing. Says Russound's Director of Marketing and Public Relations Peter Hoagland, "It's a particularly powerful product for new home construction. We were just at the Builder Show, and something that's simple to install and simple to use is just what they're looking for." Goldfinch agrees, saying, "It's good for people in the building industry because you have clear guidelines and a standard solution."

Whether ABus will become that standard solution, or part of it, remains to be seen. But the custom-install business is still in its formative stages. With structured wiring services now available from so many different sources, a simple path for the builder, C-tailor or system designer, may turn out to be a popular one.

CR



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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Application of: Distributed Stereo System

Leonard Colin Andrews

Group Art Unit: 2644

Serial No.: 09/485,657

Examiner: Justin I. Michalski

Filed: March 24, 2000

**DECLARATION UNDER 37 CFR 1.132**

Jason Knott declares as follows:

1. I am the editor-in-chief of CE Pro [Custom Electronics Professional], a publication of EH Publishing, Inc., which is the leading trade publication for installers, retailers and VARs in the custom electronics industry. We have a current audited circulation of over 35,000 readers. The company also runs the Electronic House Expo, which is a major annual trade show for the industry. I have been involved in publishing within this industry since 1990. It is part of my role to seek out and evaluate the innovations and emergent technologies in the industries served by our readership.
2. I first became aware of the distributed audio system known as A-BUS in 2000. A-BUS is a distributed stereo audio system using a Category 5 four-pair twisted cable to carry at least audio signals and system power from a power supply and source in one room to amplifiers and speakers in another room. The audio signal is carried on two of the pairs of the cable and power is carried on a third pair. The fourth pair can be used for data and status signals.
3. The introduction of the technology developed by LeisureTech Electronics of Sydney, Australia through its A-BUS products has made a major impact on the consumer electronics industry and specifically in the custom installation category. The footprint of A-BUS is getting bigger every year in that sector with a growing number of manufacturing companies from all areas of the industry that have adopted the A-BUS format. A-BUS products were featured in Electronics House Magazine's Top 50 products of the year in 2001 and 2002. They also received several industry awards from the Electronic House Expo, including Distributed Audio Awards for Best Multi-Room category, Best Overall Category and Alternative Transmission Technology.
4. Market acceptance has been based on the simplicity of the A-BUS system. In an industry where new technologies appear on almost a daily basis, A-BUS has succeeded



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4. Market acceptance has been based on the simplicity of the A-BUS system. In an industry where new technologies appear on almost a daily basis, A-BUS has succeeded because it provides simple solutions, rather than complex processes. A-BUS only needs a single Cat 5 cable from the main audio system to the distribution hub(s) in the structured wiring panel. In the past, traditional systems suffered from signal degradation from long speaker cable runs. Many in the industry believed that the low-gauge cable could not deliver enough power and that it would suffer from noise problems. LeisureTech claims to have overcome these concerns in a way that enables A-BUS to deliver high-quality signal to every room.

5. The use by A-BUS of Category 5 cable has had other advantages. Installers are already familiar with Cat 5 and have the tools and experience to handle the cable quickly and efficiently. It is also an inexpensive cable with a low profile and a damage-resistant outer sheath that makes it more cost-effective and easier to install than heavier speaker cable and data cable required for traditional systems. Additionally, because of the familiarity of Cat 5 wire in the construction and home security industry, the simplicity of A-BUS makes it possible for installers from associated professions such as security, data and electrical to design and install multi-room audio systems with A-BUS without special training. The low cost of Cat 5 cable makes it practical for builders to pre-wire the whole house for multi-room audio. The new homeowner may choose to install a simple A-BUS system or a sophisticated A-BUS system with multi-source capability. A-BUS systems are very easy to upgrade using standard Category 5 connectors.

6. With the simplicity of A-BUS and its use of Cat 5 cable, LeisureTech has been able to create an industry platform that has attracted companies from all areas of the audio market. One reason for that attraction is that A-BUS-enabled products are compatible with all other A-BUS products. For example, receivers from Harman/Kardon and from Onkyo Integra have A-BUS/Ready sockets which serve to replace the traditional Speakers 'B' facility and provide an outlet to easily extend audio entertainment into as many additional rooms as required.

7. In the traditional custom audio market, Russound has a wide range of A-BUS products and PhaseTech, a Florida-based speaker manufacturer, has introduced A-BUS as its multi-room solution, as have other speaker manufacturers such as OPUS (UK) and Jamo (Denmark). In the fast-growing structured wiring market, which provides telephone, data, video, security from a centralized panel, A-BUS has become a well-accepted audio distribution standard with many major suppliers now offering A-BUS solutions via Category 5. These include: OnQ Hone, Honeywell, AMP/Tyco, EATON, Home Director, UStec and Channel Vision.

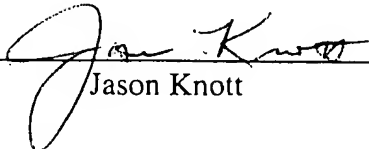
8. A-BUS technology has played a key role in the rapid growth and expansion of multi-room entertainment in our industry. I believe this is because A-BUS multi-room audio systems provide a combination of reliable performance coupled with value and quality.

9. Attached to this declaration are true copies of articles published in our magazines

relating to A-BUS technology.

All statements which I have made in this Declaration of my own knowledge are true, and all statements which I have made in this Declaration on information and belief are believed to be true. I have also been warned that willful false statements and the like are punishable by fine or imprisonment, or both under §1001 of Title 18 of the United States Code and may jeopardize the validity of this application or any patent issuing thereon.

Date: 11/29/04

  
\_\_\_\_\_  
Jason Knott



# Structured WIRING SYSTEMS

Understanding the three key levels  
of functionality in a structured wiring package is  
important to help you determine the best fit for  
your customer.

# 101

by John Galante

## ROI

- By 2004 nearly half of all housing starts will include structured wiring. Stay ahead of the curve.
- Understand the lingo and know what questions to ask before you start shopping.
- A comprehensive list of resources will help you get started.

**S**tructured wiring systems are hot. Promoted by suppliers and installing companies as the “fourth utility” and “digital plumbing,” structured wiring systems have increased market penetration from fractions of a percentage in the mid '90s to better than 12% last year in single-family home starts, according to the Dallas-based research firm, Parks Associates. By 2004, Parks projects that nearly half of all starts will include a structured wiring system. ■ **THE PRIMARY COMPONENTS** A number of manufacturers offer structured wiring systems. Following a definition created by Wiring America's Homes, a consumer educational campaign of the Home Automation & Networking Association ([www.connectedhome.org](http://www.connectedhome.org)), a system is composed of three main parts.

First, a service center, also called the distribution panel, works like a sophisticated switchboard. Outside services, including cable TV, telephone, DBS satellite, Internet and the like, enter this panel and are distributed to locations throughout the house. The system is similar to the one used by electrical breaker panels in controlling electricity flow.

Certain services like digital cable, digital satellite, high-speed Internet and HDTV require the second part of the wiring system, high-performance cables, to allow full access throughout the home. Most systems include RG-6 coaxial cable for TV and video distribution, and Category 5 or better twisted-pair cable for telephone and data. RG-6 coaxial cable provides maximum protection from interference with the TV picture. Category 5 or better cable provides high-speed access to multiple phone lines without cross-talk. Because the coaxial and twisted-pair data and phone cabling are frequently run together to universal service outlets, they are often bundled to simplify installation (See Table, page 62.)

Each room has the third part of the wiring system, the outlet, which can be customized to users' specific needs based on which services they want in each room (cable, Internet access, telephone, etc.). Outlets that feature connections for voice, video and data services on a single plate are coming to be known as multimedia or universal service outlets.

## KEY DIFFERENCES

Functionally, there are few differences between structured wiring systems. "All these systems will essentially behave the same to a certain degree," says Doug Fikse, president of OnQ Technologies, a major supplier of structured wiring packages. "Where a builder has to make his evaluation is on delivery, service and the program that [the manufacturers] wrap around their products."

"There are a lot of companies that take the existing telephone and TV requirement and do nothing more than provide a connection and good cable for that," Fikse continues. These companies may call such solutions "structured wiring," but in most cases, homebuyers will demand more features for their money. This will require a structured wiring system with greater intelligence. Manufacturers provide this intelligence in the form of modules that install into the distribution panel. One module, for example, might facilitate a computer network; another might distribute DSS to various outlet locations. Without these modules, a distribution panel is nothing more than a box into which wiring terminates.

The types of modules and the number of outlets included in a package differ between manufacturers. Some packages might include a cable modem for Internet access; some might distribute video to four locations; still others might reach as many as 12. Explore the features included in each package to determine the best one for your market. Not all features that sound great are actually practical. A structured wiring system that comes with a DSL modem, for example, will require that a home have access to DSL service. Also consider whether a package includes addi-

tional wiring for security and audio. "In our recommended scenario we had prewiring for security, for audio, and we strongly recommend that in at least one outlet in each major room there be a Category 5 RG-6 configuration," says Mark Schmidt, Home Director vice president of sales and marketing. (Home Director is a networking technology company delivering products and services for home networking solutions.) With so many options available,

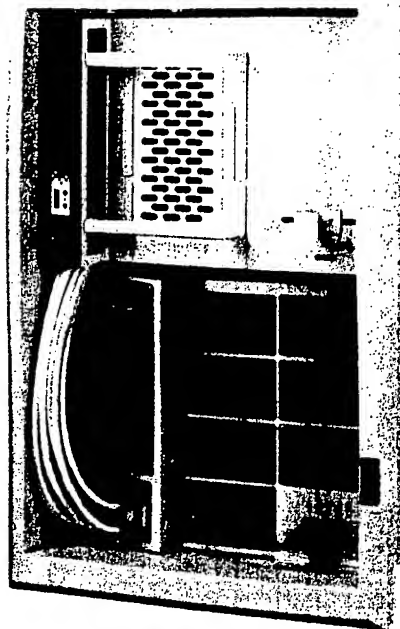
it's difficult to pinpoint a cost for a structured wiring system. Generally, the range is from \$750 to \$2,000, installed.

## THREE LEVELS OF SOLUTIONS

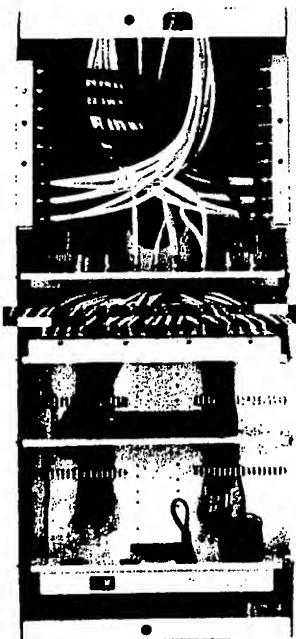
Wiring America's Homes has established three solutions for structured wiring systems in new homes, based on the approved industry standard (TIA 570-A). The recommended solution provides an infrastructure to support basic and advanced systems, including multimedia and interactive communications services, home-office components and distribution of digital television signals. The minimum solution provides an infrastructure to support and integrate basic systems—such as telephone, satellite, CATV and data services—now, while allowing for customization and evolution as new technologies are developed. This solution limits access to many services derived from the broadband pipe (used in the recommended solution). The upgraded solution integrates the recommended solution with an added step to allow for easy upgrading of the wiring system. This includes the installation of 2-inch PVC piping from the attic to the basement for ease of installing future wires and/or fiber optic cable, which provides maximum available bandwidth.

## STANDARD WIRING ON THE WAY

The Telecommunications Industry Association's TR 42.2 Committee, responsible for the maintenance and updating of the TIA 570-A Residential Cabling Standard, started work on an addendum to the standard last year. The addendum will address prewiring for entertainment systems (specifically surround-sound audio for home theater and multiroom audio), control systems (automated lighting, HVAC and whole-house control) and security. The committee's goal is to finalize draft standards for infrastructure wiring of these subsystems by the end of the year. A meeting will be held in conjunction with the Electronic House Expo in Long Beach, Calif., Oct. 24-27, 2001. For more information, visit [www.tiaonline.org](http://www.tiaonline.org).



■ The Ilan 800b home networking server by UStec, above, and the Home Director Network Connection Center, below, are examples of structured wiring system distribution panels.



## Great Packages

Prewire Cable Schedule											
Job: J.D. Smith Residence						Job ID: R345					
Location: 1438 SW Cedar Circle - 3315427						Date:					
Prepared by:						Date:					
Reviewed by:						Date:					
ID	Path	From	To	Term	Term	Run Length	CS	RS	CS	RS	NOTES
1	1	1	1	1	1	1	1	1	1	1	
2	2	2	2	2	2	2	2	2	2	2	
3	3	3	3	3	3	3	3	3	3	3	
4	4	4	4	4	4	4	4	4	4	4	
5	5	5	5	5	5	5	5	5	5	5	
6	6	6	6	6	6	6	6	6	6	6	
7	7	7	7	7	7	7	7	7	7	7	
8	8	8	8	8	8	8	8	8	8	8	
9	9	9	9	9	9	9	9	9	9	9	
10	10	10	10	10	10	10	10	10	10	10	
11	11	11	11	11	11	11	11	11	11	11	
12	12	12	12	12	12	12	12	12	12	12	
13	13	13	13	13	13	13	13	13	13	13	
14	14	14	14	14	14	14	14	14	14	14	
15	15	15	15	15	15	15	15	15	15	15	
16	16	16	16	16	16	16	16	16	16	16	
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22	22	22	22	22	22	22	22	22	22	22	
23	23	23	23	23	23	23	23	23	23	23	
24	24	24	24	24	24	24	24	24	24	24	
25	25	25	25	25	25	25	25	25	25	25	
26	26	26	26	26	26	26	26	26	26	26	
27	27	27	27	27	27	27	27	27	27	27	
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31	31	31	31	31	31	31	31	31	31	31	
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67	67	67	67	67	67	67	67	67	67	67	
68	68	68	68	68	68	68	68	68	68	68	
69	69	69	69	69	69	69	69	69	69	69	
70	70	70	70	70	70	70	70	70	70	70	
71	71	71	71	71	71	71	71	71	71	71	
72	72	72	72	72	72	72	72	72	72	72	
73	73	73	73	73	73	73	73	73	73	73	
74	74	74	74	74	74	74	74	74	74	74	
75	75	75	75	75	75	75	75	75	75	75	
76	76	76	76	76	76	76	76	76	76	76	
77	77	77	77	77	77	77	77	77	77	77	
78	78	78	78	78	78	78	78	78	78	78	
79	79	79	79	79	79	79	79	79	79	79	
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84	84	84	84	84	84	84	84	84	84	84	
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87	87	87	87	87	87	87	87	87	87	87	
88	88	88	88	88	88	88	88	88	88	88	
89	89	89	89	89	89	89	89	89	89	89	
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91	91	91	91	91	91	91	91	91	91	91	
92	92	92	92	92	92	92	92	92	92	92	
93	93	93	93	93	93	93	93	93	93	93	
94	94	94	94	94	94	94	94	94	94	94	
95	95	95	95	95	95	95	95	95	95	95	
96	96	96	96	96	96	96	96	96	96	96	
97	97	97	97	97	97	97	97	97	97	97	
98	98	98	98	98	98	98	98	98	98	98	
99	99	99	99	99	99	99	99	99	99	99	
100	100	100	100	100	100	100	100	100	100	100	

■ A cable installation schedule can be created in a standard spreadsheet or word processor program. Key fields should include cable ID of each line, even if it is part of a bundled cable.

## SYSTEM DOCUMENTATION, LABELING, TEST & INSPECTION

Another unfinished piece of business in the standards arena is documentation and labeling of system components. The TR 42.2 Committee referred development of this standard to another TIA committee working on the same standard for commercial buildings. Meanwhile, more and more systems are installed, some, unfortunately, without proper documentation. According to Helen Heneveld, vice president of The Training Dept., a leading training and education provider in the structured wiring arena, installers should document the destination, purpose, and cabling type of each run and should label all cables at the distribution device, including those not connected. The Training Dept. also recommends that each cabling run be tested for continuity (i.e., the run connects the jack to the intended service), length and resistance (i.e., signal loss

## Around the Lingo

Features	Description	Benefits
Distribution box	The distribution box is a stand-alone piece of equipment that contains distribution devices for voice, data and video. It must be located in a place that is readily accessible to cabling maintenance.	The distribution center allows the wiring system to be customized and updated as technologies are developed. It provides universal access to various networking elements within the home as well as connectivity to service providers.
Star topography	All cables are strung in a star formation that allows all wires to have a direct link from the distribution box to the outlet.	The efficient star topography allows system changes to be made without the hassle of having to pull new wires. In addition, services are not disrupted or impaired by other online connected devices.
Universal service outlets	These outlets are designed to support a full range of communication technologies with a variety of flexible configurations, including voice, data and video jacks.	Universal outlets allow the homeowner to determine which technologies will be used in each room in the home. Even after wiring system installation is complete, outlets can be changed to meet the homeowner's changing needs.
Recommended wiring	Recommended wiring consists of: <ul style="list-style-type: none"> <li>■ two CAT 5 cables (CAT 5e preferred);</li> <li>■ two RG-6 quad-shielded coax cables;</li> <li>■ one dual CAT 5/dual coax outlet to key rooms in the house, including home office/den/study, kitchen, family/great room, each bedroom, multimedia room, master bathroom, utility room, dining room.</li> </ul>	Recommended wiring provides for basic and advanced services, including multimedia and interactive communication services. This grade supports both current and developing technologies including multiple communication technology in the home office (multiple computers, fax machines, phone lines, etc.) and extensive home-theater capabilities (DVD, etc.).
Minimum wiring	Minimum wiring consists of: <ul style="list-style-type: none"> <li>■ one four-pair UTP CAT 5 cable;</li> <li>■ one RG-6 coaxial cable to key rooms in the house, including home office/den/study, kitchen, family/great room, each bedroom.</li> </ul>	Minimum wiring provides the basic structured wiring required for telephone, satellite, CATV and data services. This allows a homeowner to reap basic benefits such as multiple phone and modem lines and satellite television. Minimum wiring, while technically compatible with current cable modem or DSL broadband services, limits access to many services derived from the broadband pipe.
Upgrade wiring	This wiring is the same as recommended wiring, plus 2-inch PVC piping from the attic to basement to ease installation of additional wiring or fiber optics in the future.	Upgrade wiring is a kind of contingency plan to accommodate the unknown future of telecommunication services and technology.

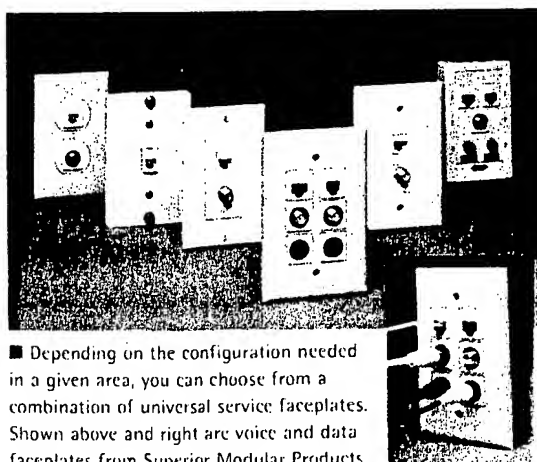


■ Cables should be labeled before pulling.

over distance). For Category 5 cabling, installers should perform wire mapping to ensure that the four pair of cabling are connecting the desired service to the desired jack. Field-test instruments are available through vendors such as Microtest and Fluke to assist in this process.

The standards committee will continue to define and specify the parameters for structured wiring, but OnQ's Fikse indicates that there's no time like the present for builders to integrate structured wiring programs into their construction plans.

"This is a sign of the times," says Fikse. "You're going to have to have more and more applications that are going to tie into this network kind of wiring, and for a few hundred dollars you can have it in your house, rolled in your mortgage for a few bucks. It's a small investment relative to the benefit that you get down the road, and even currently in the short term. Now is the time to do it." **THB**



■ Depending on the configuration needed in a given area, you can choose from a combination of universal service faceplates. Shown above and right are voice and data faceplates from Superior Modular Products.

## Resources

Manufacturers	Distrib. Panels	Wire & Cable	Outlets	Test Equip. Inst. Tools	Contact
ADC	x				<a href="http://www.adc.com">www.adc.com</a>
AMP (net connect)	x				<a href="http://www.amp.com">www.amp.com</a>
Avaya	x				<a href="http://www.avaya.com">www.avaya.com</a>
Belden		x			<a href="http://www.belden.com">www.belden.com</a>
Belkin	x				<a href="http://www.belkin.com">www.belkin.com</a>
Channel Vision Tech.	x	x			<a href="http://www.channelvision.com">www.channelvision.com</a>
CommScope		x			<a href="http://www.commscope.com">www.commscope.com</a>
Condumex		x			<a href="http://www.condumex.com.mx">www.condumex.com.mx</a>
Cooper Wiring Devices	x		x	x	<a href="http://www.cooperwiringdevices.com">www.cooperwiringdevices.com</a>
DSC	x				<a href="http://www.dsc.com">www.dsc.com</a>
Elan Home Systems	x				<a href="http://www.elanhomesystems.com">www.elanhomesystems.com</a>
Elk	x				<a href="http://www.elkproducts.com">www.elkproducts.com</a>
Fluke Networks				x	<a href="http://www.flukenetworks.com">www.flukenetworks.com</a>
FutureSmart Networks	x	x	x		<a href="http://www.futuresmart.com">www.futuresmart.com</a>
Genesis Cable Systems		x			<a href="http://www.genescable.com">www.genescable.com</a>
GE-Smart	x				<a href="http://www.ge-smart.com">www.ge-smart.com</a>
Greyfox	x				<a href="http://www.greyfox.com">www.greyfox.com</a>
Holovision	x				714-434-6904
Home Director	x		x		<a href="http://www.homedirector.com">www.homedirector.com</a>
HomeNet Technologies	x				630-585-9201
Honeywell	x				<a href="http://www.honeywell.com/yourhome/">www.honeywell.com/yourhome/</a>
Ideal Industries				x	<a href="http://www.idealindustries.com">www.idealindustries.com</a>
Innovative Connectors	x				<a href="http://www.icc.com">www.icc.com</a>
Keystone Wire & Cable		x			<a href="http://www.kestonewire.com">www.kestonewire.com</a>
Labor Saving Devices				x	<a href="http://www.lsdinc.com">www.lsdinc.com</a>
Leviton	x	x	x	x	<a href="http://www.leviton.com">www.leviton.com</a>
Liberty Wire & Cable		x			<a href="http://www.libertycable.com">www.libertycable.com</a>
Microtest				x	<a href="http://www.microtest.com">www.microtest.com</a>
Mohawk/CDT		x			<a href="http://www.mohawk-cdt.com">www.mohawk-cdt.com</a>
Molex Premise Networks	x				<a href="http://www.molex.com">www.molex.com</a>
Monster Cable	x	x	x		<a href="http://www.monstercable.com">www.monstercable.com</a>
Multiplex Open House	x				<a href="http://www.channelplus.com">www.channelplus.com</a>
Nordx	x				<a href="http://www.nordx.com">www.nordx.com</a>
OnQ Technologies	x	x	x	x	<a href="http://www.onqtech.com">www.onqtech.com</a>
Ortronics	x				<a href="http://www.ortronics.com">www.ortronics.com</a>
Panduit	x				708-532-1800
Pass & Seymour	x				<a href="http://www.pass-seymour.com">www.pass-seymour.com</a>
Remee		x			<a href="http://www.remee.com">www.remee.com</a>
Siemon Co.	x		x		<a href="http://www.siemon.com">www.siemon.com</a>
Signature Wire	x	x			<a href="http://www.signaturewire.com">www.signaturewire.com</a>
SmartWorld	x		x		<a href="http://www.smart-america.com">www.smart-america.com</a>
Southwire Cyber Tech.		x			<a href="http://www.southwire.com">www.southwire.com</a>
Square D	x				<a href="http://www.squared.com">www.squared.com</a>
Sunshine Wire & Connector		x			<a href="http://www.sunshinewire.com">www.sunshinewire.com</a>
Superior Modular			x		<a href="http://www.supermod.com">www.supermod.com</a>
TII Industries	x				<a href="http://www.tii-industries.com">www.tii-industries.com</a>
USec	x	x	x		<a href="http://www.usternet.com">www.usternet.com</a>
West Penn Wire/CDT		x			<a href="http://www.westpenn-cdt.com">www.westpenn-cdt.com</a>

# A SOUND Investment

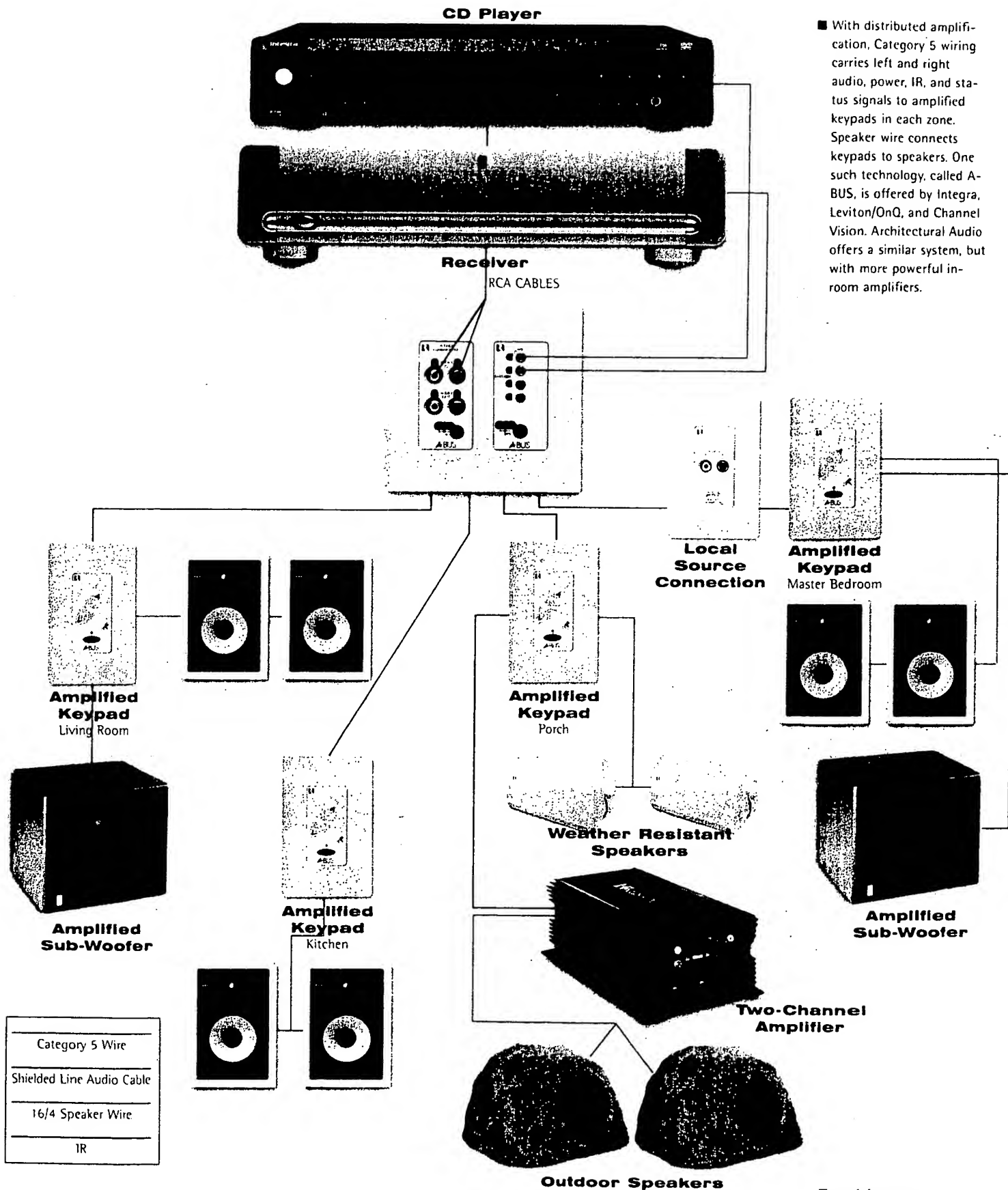
Multiroom audio for production homes

by Charles Wardell

## ROI

- Cost estimates for three sample audio systems with distributed amplification.
- Tips for a quality installation.
- Examples of alternative systems.

A few years ago, virtually no production builders included multiroom audio in their homes. That's changing. According to the National Association of HomeBuilders, 57 percent of U.S. builders say they now offer it as an option. But offering and selling are two different things: only 9 percent of new homes actually got a multiroom system last year. Builders aren't selling much audio because consumers aren't asking for it. And consumers aren't asking for it because nobody is telling them about it. In fact, audio manufacturers and installers trace the problem to builders' salespeople—they just don't feel comfortable enough with the technology to present it effectively. ■ In the next few pages we provide some basic information that, we hope, will help you better understand the systems most appropriate to production homes. We will focus on one particular type of system to outline what you will get for how much money.



■ With distributed amplification, Category 5 wiring carries left and right audio, power, IR, and status signals to amplified keypads in each zone. Speaker wire connects keypads to speakers. One such technology, called A-BUS, is offered by Integra, Leviton/OnQ, and Channel Vision. Architectural Audio offers a similar system, but with more powerful in-room amplifiers.

## The Distributed Audio Alliance

The Distributed Audio Alliance serves as an educational resource for consumers, builders and installers wanting to learn more about multiroom audio. The DAA consists of leading manufacturers of multiroom audio equipment and industry organizations that focus on hard-wired, professionally installed systems. Check them out at: [www.multiroomaudio.com](http://www.multiroomaudio.com)

A little knowledge should help you understand why the builders responsible for that 9 percent are finding multiroom audio a pretty easy sell. New technology has made these systems simpler to use and less expensive, with a basic, entry-level setup system starting at around \$1500. "We hear that when builders make audio standard, not only do they increase sales but they also increase selling price," says Buzz Delano, a sales manager with audio manufacturer Sonance Systems. Builders who spec audio for their homes report that clients who had distributed audio in the past don't want to be without it in the future, and will often pay for an upgraded system.

### WHAT IT IS

Multiroom audio is a professionally installed system that includes sound sources (CD players, MP3 servers, etc.), wires, controls, and speakers. The sources pipe sound to multiple "zones," usually individual rooms. Each room has its own volume control and speakers.

In the traditional audio system, a big central amplifier (at least 50 watts per channel) at the distribution point pushes an amplified signal over 16-gauge, 4-conductor (16/4) speaker wire to each room. In the newer systems, Category 5 wiring connects the amplifier to wall-mounted volume controls.

While these systems provide excellent sound, costs start at \$700 per room. But recently, a less expensive technology has taken aim at the production market: distributed amplification. You can get these systems for as little as \$450 per room, including sources.

There's no central amplifier in a distributed system. Instead, the source sends an un-amplified signal to a distribution hub, which may be in the living room or in the home's structured wiring panel. The signal is then sent to each room. A small amplifier, sometimes in the volume control itself, drives the speakers in that room.

Each room need be served by only one wire: audio, power, and control signals all travel over inexpensive Category 5 wiring to the in-room volume controls. As with the traditional system, two runs of 16/2 wire (one per speaker) connect each volume control to the in-wall or in-ceiling speakers it serves.

These new systems are changing how audio is sold. Rather than being seen as a separate entertainment system, audio is now as likely to be part of the structured wiring. For instance, A-BUS, the most popular distributed amplification technology, is offered by traditional audio manufacturers Russound and Integra, as well as by structured wiring providers Leviton/OnQ and Channel Vision. A similar system is made by Architectural Audio, a division of Sonance Systems.

One oft-cited drawback of distributed amplification is power. While a central amplifier might provide 25 watts of power to each speaker, A-BUS systems send only about 7½ watts. Critics say that's great for background music, but not enough to drive a home theater or fill a big room with sound. Russound counters that users can buy supplementary amps where they need more power, and still pay a lower overall system cost. (Architectural Audio's amplified

volume controls send 30 watts to each speaker, with costs that start at around \$500 per room.)

### PRICING A SYSTEM

If you're a production builder, you might want to have at least one floor plan with basic multiroom audio, along with a way for buyers to upgrade one or two levels, if they like.

Below, we describe three A-BUS type systems that would be appropriate for a production home, all with distributed amplification and Category 5 wiring. We've tried to show what buyers get for their money in each case. Prices do not include installation or infrastructure wiring.

Our Good and Better systems send the same source to every room. Our More Better system is smarter (and more expensive), letting family members listen to different sources simultaneously from different rooms. Our Best system is for custom homes. We include it for comparison only. We've listed total system costs, so you can tell your clients about how much they should budget for each system. Note, however, that the builder usually provides just the infrastructure (wiring, speakers, and controls).

#### Good

A typical entry-level system includes 4 zones: 3 bedrooms, each on its own zone, and the living room or kitchen on another. Each zone will have a pair of speakers and an amplified volume control. These systems can handle only a single source.

Approximate equipment cost to the client

Four amplified volume controls, a hub, a power supply: \$700

Four pairs of speakers: \$1,000

A DVD player: \$100

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Total cost: \$1,800, or \$450 per zone

#### Better

This is the Good system with infrared receivers built into the keypads. A handheld remote can be used to adjust the volume or turn the system on and off. This system can handle a couple of sources, but you have to listen to the same source in every room. Better systems also often include outdoor sound: a zone in the patio or garden. The outdoor speakers will require a separate amplifier to boost the signal.

Approximate equipment cost to the client

Five amplified volume controls, a hub, a power supply, an IR remote: \$1,300

Five pairs of speakers: \$1,300

A receiver: \$200

A DVD player: \$100

A two-channel amplifier for the outdoor zone: \$300

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Total cost: \$3,200, or \$640 per zone

#### More Better

For this system, take the better system and add better speakers as well as another indoor zone. (That's one out-



door and five indoor zones.) Instead of simple volume controls in each room, this system's keypads also let users choose from up to six different sources—the CD player, the music server, the receiver, or even digital music channels from the customer's satellite or cable service. A different source can be played in each zone. This system also includes one local input that's installed in one room. When a television or other source is plugged into this, sound is heard through the speakers in that room.

Approximate equipment cost to the client

Six volume controls, a hub, a power supply, an IR remote, a local input: \$1,900

Six pairs of speakers: \$2,400

A two-channel amplifier for the outdoor zone: \$300

A receiver: \$200

A 300-disc CD changer: \$250

A DVD player: \$100

Total cost: \$5,150, or \$860 per zone

## Best

The "best" system is, arguably, one where the audio is part of a whole-house automation system that also controls lighting, HVAC, and other home control systems. It will include touchscreen controls made by a high-end automation manufacturer. It will probably include a digital jukebox, which can manage hundreds of CDs and MP3 files, and let users sort by type of music. These systems are found in expensive custom homes. Costs start at \$15,000.

## TECH TIPS

Regardless of the system, good designs and installations will have certain things in common. Some tips:

- Besides the active zones listed in each sample system, you might also want to ask your installer to run Cat 5 to other rooms, and to document their terminations. With wiring prices of 5 or 10 cents a foot, the extra cost is minimal. But if the buyers want to convert the basement to a bonus room in a few years and the wiring is waiting for them, you're a hero.
- If you don't install a sound system, consider pre-wiring the home anyway. A good pre-wire system is to run Cat 5 and 4-conductor speaker wire from the source location to each potential zone. Loop the wires where each volume control will go, and continue both wires to each speaker location. That way, the system will have the necessary wiring for central or distributed amplification. And as manufacturers roll out digital systems over the next few years, with amplification at the speaker itself, having the Cat 5 in place will let the homeowner switch to the new speakers without having to snake new wire through existing walls.
- The electronics installer should run speaker wiring when the voice/data/video wiring (structured wiring) is being installed. Chances are it will be the same installer anyway. The installer should never run an audio cable

through the same hole in a joist or wall stud as a high-voltage electrical wire: Magnetic interference from electrical wiring can interfere with low-voltage signals; in an audio system the result could be unwanted hum and static coming from your speakers. The electronics installer

## Other Entry-Level Systems

Distributed amplification isn't the only choice for multiroom audio. Centrally amplified systems remain popular, and audio manufacturers offer moderately priced systems aimed at production builders. Here's what some of the leading companies are offering. Prices do not include installation.

### System6 from Elan Home Systems

is an integrated audio controller and amplifier that provides 12 channels of amplification at 40 watts per channel. It allows up to six audio sources to be accessed independently by keypads



located in up to six separate zones. Price: \$3,990. That includes the controller, six pairs of in-wall or in-ceiling speakers, and 6 keypads. It does not include source components.

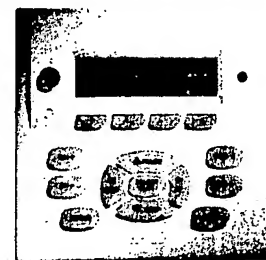
### The Niles ZR4630 Multizone Receiver

(the company has nicknamed it Gloria) will distribute three sources to up to six zones. It includes a built-in AM/FM stereo tuner and six stereo power amplifiers that will deliver 30 watts per channel per zone. Keypad controls are served by Cat 5 wiring, and speakers by speaker wire. Cost: \$2,995.



That includes the ZR-4630 plus six keypads. It does not include speakers.

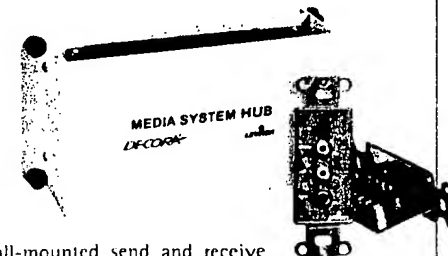
The Xantech MRC44 is a prepackaged system that will send four audio/video inputs to four zones. Any source can be controlled from any room, and multiple sources can be selected in different rooms simultaneously. Parents can control what entertainment the kids can get in their rooms. Category 5 wiring connects the controller/amp to the keypads; speaker wire runs from the controller/amp directly to the speakers. Cost: about \$3,000. That includes a controller/amplifier, four wall keypads and four IR emitters. (The emitters let users control the system with a handheld remote.) It does not include sources or speakers.



### Leviton's Decora Media System doesn't

fit our definition of multiroom audio. Instead it's an add-on to such systems. It recognizes the fact that people have music stored in different formats—CDs, cassette tapes, MP3 files on the home computer—and that many own mini-systems like the Bose Wave Radio. The Decora System lets you play all of these throughout the house. It includes a central hub, and wall-mounted send and receive plates, all knitted together by Category 5 wiring in a star configuration.

The hub takes the output from a device plugged into a send plate (a cassette player, for instance) and sends it to any device (a radio, an MP3 player, or even an old stereo system) that's plugged into a receive plate. The system can serve up to six such devices. Cost: \$650 for the hub and six wall plates.





should know this. (If he doesn't, think about getting another installer.) Since the electrician might not know, make sure the electrical rough-in is done before the electronics installer begins.

- Sound quality on any system is like a chain: It will be only as good as the system's weakest link. Good speakers won't sound as good if served by a sloppy wiring job, and the best components and wiring will be only as good as the speakers you put on them.
- Long lengths of speaker wire can damage sound quality. If wire runs are too long, you can lose power and the speakers won't reproduce frequencies as accurately.
- Place in-room controls where they're convenient to use. A good spot is next to an existing light switch. That way, you won't have to worry about someone putting furniture in front of it.
- You may want to offer the option of a closet to house the source components. If so, this closet should measure about 84 inches high by 24 inches wide by 26 inches deep, at a minimum. If it's enclosed, include a ventilation fan to keep the components cool.

## Digital Systems

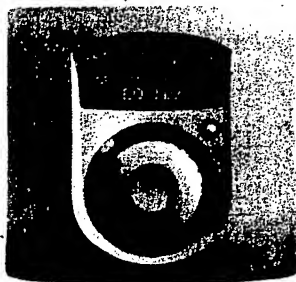
Most audio manufacturers see digital distribution as the future of audio. Benefits include better control, less static, even the ability to send music to specific speakers.

Zon Audio is the first all-digital system, distributing sound over an Ethernet-based network. Sources are plugged into wall-mounted input modules. (Each zone has an input module, and sources plugged into any input can be played in any zone.) These distribute the digital signals to an amplified controller in each zone. Users can scroll through a menu to choose between sources. Short runs of speaker wire connect controllers to speakers. Cost: \$500 to \$600 per room. That includes an amplified controller and input module for each room. It doesn't include speakers or source.

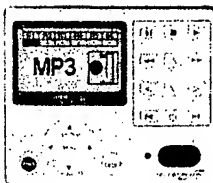
NetStreams' Musica distributes up to four sources to six rooms simultaneously. (It can be expanded to 12 rooms.) Like the Zon system, Musica's amplified in-room controls have LCD screens that let users choose from various menu options. The market is higher-end production builders and custom homes. Price: A six-room kit costs roughly \$800 per room. That includes a distribution hub, six keypad/amplifier modules, four IR emitters, an handheld remote. It doesn't include speakers or sources.

The current Musica uses traditional analog signals. But in September, the company plans to introduce Musica Digital: an IP-based system that, it says, will have enough bandwidth to handle high-definition television. Each device on the new system will act as a miniature Web server with its own IP address. Users will be able to search music files by a number of parameters (timeframe, artist, genre) from any IP-based device, whether a desktop computer or a handheld media device. Existing owners will be offered a trade-up option.

In September, NetStreams will roll out an IP-based system.



Zon is the first all-digital system.



## SPEAKING OF SPEAKERS

With speakers, the obvious priority is sound quality—we talk more about that in the article on that starts on page 40. But you also have to make sure the speakers are correctly sized and placed, and that they mesh with the home's architecture.

**Sizing.** How powerful a speaker needs to be depends on how big a room it's in. For a 150- to 200-square-foot room, a typical 2-way speaker with a 6-inch woofer will do. If room volume increases—especially if ceilings get higher—you can move up to a 3-way speaker with an 8-inch woofer. These are rare in production homes, but they handle more power because each driver gets less of it. And they take less power to fill a room with sound.

You also need to think about what people will do in each room. Because people respond best to ear-level sound, family rooms and home theaters call for relatively powerful in-wall speakers. Ceiling speakers, on the other hand, are better at dispersing sound. They're perfect for kitchens and dining rooms, where people are more likely to want background music.

**Placement.** Filling a room with sound is easier with correctly placed speakers. This is both an art and a science. In the family room, for instance, wall speakers should face toward the main sitting location; in the bedroom, they're best placed over the foot of the bed. (Of course you have to know where the bed will be placed.) With ceiling speakers, the best placement will depend on ceiling height. Of course the higher the ceiling, the farther apart the speakers can be. Your electronics sub should know the guidelines. You may need more than two speakers to do a proper job.

Built-in speakers can look awkward if not aligned with existing light fixtures or other built-ins. In a dining room, for instance, you might put ceiling speakers in less than ideal spots so they blend in with the recessed ceiling lights.

**Aesthetics.** Built-in speakers may have round or square grilles. While some designers don't have a preference, most people expect to see square speakers in walls, round ones in ceilings. Most speaker grilles can be painted to match the room's decor.

## SALES STRATEGIES

People who sell built-in audio say it's an amenity most families can agree on. "It's accepted by both sides of the family," says Chad Gallup of AVS Home Systems, a system integration company in Seattle. When working with couples, Gallup finds the husband more likely to want a dedicated theater room, but he says that both husband and wife quickly warm up to audio.

When presenting an upgrade, it's best not to start with the speakers, but conceptually with the type of system. Then discuss products for each room. "Don't show the customer a set of \$800 speakers for the master bath until they've settled on the system," says Alan Carmack of Progressive Audio in Cleveland, Ohio. "Why would you pick out granite countertop before the kitchen is drawn?" **THE**

## Building the Infrastructure with Wire and a Panel

Promoted by suppliers and installing companies as the “fourth utility” and “digital plumbing,” structured wiring is the building block of the home technology market. In just five short

years, the penetration of structured wiring in new single-family housing has climbed from 1 percent in 1996 to more than 42 percent in 2002, according to a joint study by the National Association of Home Builders Research Center (NAHBRC) and CEA. By 2004, penetration is predicted to be more than 50 percent of new homes. Overall, more than three out of every four homebuilders (78 percent) constructed at least one home in 2002 with structured wiring.

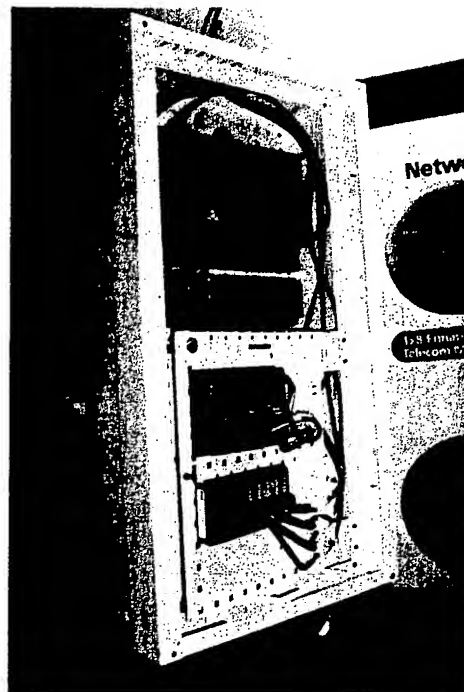
Basically, structured wiring consists of three elements: the distribution panel, the cabling and the outlets.

The distribution panel, or service center, works like a sophisticated switchboard. Outside services, including cable TV, telephone, DBS satellite and the Internet, enter the panel and are distributed to locations throughout the house. The system is similar to the

one used by the electrical breaker panel in the home to control electricity flow.

Certain services like digital cable, digital satellite, high-speed Internet and HDTV require the second part of the wiring system, high-performance cables, to allow full access throughout the home. Most systems include RG-6 coaxial cable for TV and video distribution, and Category 5 or better twisted-pair cable for telephone and data. RG-6 coaxial cable provides maximum protection from interference with the TV picture. Cat 5, Cat 5e or even Cat 6 cable provide high-speed access to multiple phone lines without crosstalk. Because the coax and the twisted-pair data and phone cabling are frequently run together to universal, or multi-port, service outlets, they are often bundled, in what is commonly called a composite cable, to simplify installation.

Each room has the third part of the wiring system, the outlets, which can be customized to users' specific needs based on which services they want in each room (cable, Internet access, telephone, etc.) Outlets that feature connections for voice, video and data services on a single plate are known as multimedia or universal service outlets. According to the NAHBRC, in 2001 the average newly built single-family home and MDU had approximately seven structured wiring outlets installed.



The distribution panel, like this new OnQ unit with a hinged expansion plate, works like a sophisticated switchboard sending services throughout the house.

### Modules and Costs To Look For

Functionally, there are very few differences among structured wiring systems. When selecting a brand to utilize, builders have to make their evaluation based on delivery, service and the program that the manufacturers wrap around their products. While those companies may call such a solution “structured wiring” in most cases your homebuyers will demand more features for their money, which will require a structured wiring system with greater flexibility.

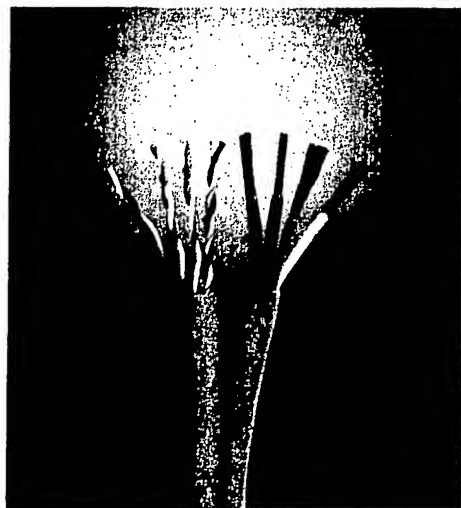
Manufacturers provide that intelligence in the form of modules that install into the distribution panel. One module, for example, might facilitate a computer network; another might

### BUILDER

- Structured wiring consists of three elements: the distribution panel, cabling and outlets.
- Understand the lingo and know what questions to ask before you start shopping.
- 78 percent of builders included structured wiring in at least one home in 2002.

### BASICS

Source: NAHBRC, CEA



This cable was specifically developed to support whole-house audio applications by Genesis.



distribute digital broadcast satellite (DBS) to various outlet locations. Without these modules, a distribution panel is nothing more than a box into which the wire terminates.

The types of modules and the number of outlets included in a package differ among manufacturers. Some packages might include a cable modem for Internet access; some might distribute video to four locations; still others might reach as many as 12 outlets. Explore the features included in each package to determine the best one for your market.

Not all features that sound great are actually practical. A structured wiring system that comes with a digital subscriber line (DSL) modem, for example,

will require that a home have access to DSL service. Also consider whether a package includes additional wiring for security and audio.

With so many options available, it's difficult to pinpoint a cost for a structured wiring system. Generally, the range is from \$750 to \$2,000, installed, depending on the size of the home. For builders looking for cost-per-square-foot recommendations, installation prices have become highly regionalized, depending on market conditions.

About \$1 per square foot (based on the total square footage of the home) seems to be a solid guideline for one Cat 5e/RG-6 run. Some builders report paying 50 cents per square foot, but

## Know the Lingo

### Distribution box

**Description:** The distribution box is a stand-alone piece of equipment that contains distribution devices for voice, data and video. It must be located in a place that is readily accessible to cabling maintenance.

**Benefits:** The distribution center allows the wiring system to be customized and updated as technologies are developed. It provides universal access to various networking elements within the home as well as connectivity to service providers.

### Star topography

**Description:** All cables are strung in a star formation that allows all wires to have a direct link from the distribution box to the outlet.

**Benefits:** The efficient star topography allows system changes to be made without the hassle of having to pull new wires. In addition, services are not disrupted or impaired by other online connected devices.

### Universal service outlets

**Description:** These outlets are designed to support a full range of communication technologies with a variety of flexible configurations, including voice, data and video jacks.

**Benefits:** Universal outlets allow the homeowner to determine which technologies will be used in each room in the home. Even after wiring system installation is complete, outlets can be changed to meet the homeowner's changing needs.

### Recommended wiring

**Description:** Recommended wiring consists of:  
Two CAT 5 cables (CAT 5e preferred);  
Two RG-6 quad-shielded coax cables;

One dual CAT 5/dual coax outlet to key rooms in the house, including home office/den/study, kitchen, family/great room, each bedroom, multimedia room, master bathroom, utility room, dining room.

**Benefits:** Recommended wiring provides for basic and advanced services, including multimedia and interactive communication services. This grade supports both current and developing technologies including multiple communication technology in the home office (multiple computers, fax machines, phone lines, etc.) and extensive home-theater capabilities (DVD, etc.).

### Minimum wiring

**Description:** Minimum wiring consists of:

One four-pair UTP Cat 5 cable;

One RG-6 coaxial cable to key rooms in the house, including home office/den/study, kitchen, family/great room, each bedroom.

**Benefits:** Minimum wiring provides the basic structured wiring required for telephone, satellite, CATV and data services. This allows a homeowner to reap basic benefits such as multiple phone and modem lines and satellite television. Minimum wiring, while technically compatible with current cable modem or DSL broadband services, limits access to many services derived from the broadband pipe.

### Upgrade wiring

**Description:** This wiring is the same as recommended wiring, plus 2-inch PVC piping from the attic to basement to ease installation of additional wiring or fiber optics in the future.

**Benefits:** Upgrade wiring is a kind of contingency plan to accommodate the unknown future of telecommunication services and technology.



Documentation and testing of wiring is vital using test equipment like this Fluke DSP 4300.

they are usually not getting outlets run throughout the home, but perhaps to only one or two rooms.

### Three Levels of Solutions

A consumer educational campaign entitled Wiring America's Homes has established three solutions for structured wiring systems in new homes, based on the industry standard (Telecommunications Industry Association 570-A). The recommended solution provides an

infrastructure to support basic and advanced systems, including multimedia and interactive communications services, home-office components and distribution of digital TV signals.

The minimum solution provides an infrastructure to support and integrate basic systems—such as telephone, satellite, CATV and data services—now, while allowing for customization and evolution as new technologies are developed. This solution limits access to many services derived from the broadband pipe (used in the recommended solution). The upgraded solution integrates the recommended solution with added features to allow for easy upgrading of the wiring system. This includes the installation of 2-inch PVC piping from the attic to the basement for ease of installing future wires and/or fiber optic cable, which provides maximum available bandwidth.

### Standard Wiring on the Way

The Telecommunications Industry Association's TR 42.2 Committee, responsible for the maintenance and updating of the TIA 570-A Residential Cabling Standard, created three addendums to the standard addressing prewiring for entertainment systems (specifically surround-sound audio for home theater and multiroom audio), control systems (automated lighting, HVAC

and whole-house control) and security.

Meanwhile, it is vital that builders create proper documentation for their structured wiring systems. Installers should document the destination, purpose, and cabling type of each run and should label all cables at the distribution device, including those not connected. It is also recommended that each cabling run be tested for continuity (i.e., the run connects the jack to the intended service), length and resistance (i.e., signal loss over distance). For Cat 5 cabling, installers should perform wire mapping to ensure that cables are properly routed and terminated. Field-test instruments are available to assist in this process.

There's no time like the present for builders to integrate structured wiring programs into their construction plans. More applications than ever are going to tie into a home network. The major selling advantage for builders of new homes is the ability to have the cost of the network rolled into a home's mortgage. For a few dollars per month, a homeowner can gain long-term and short-term benefits from a home wiring system.

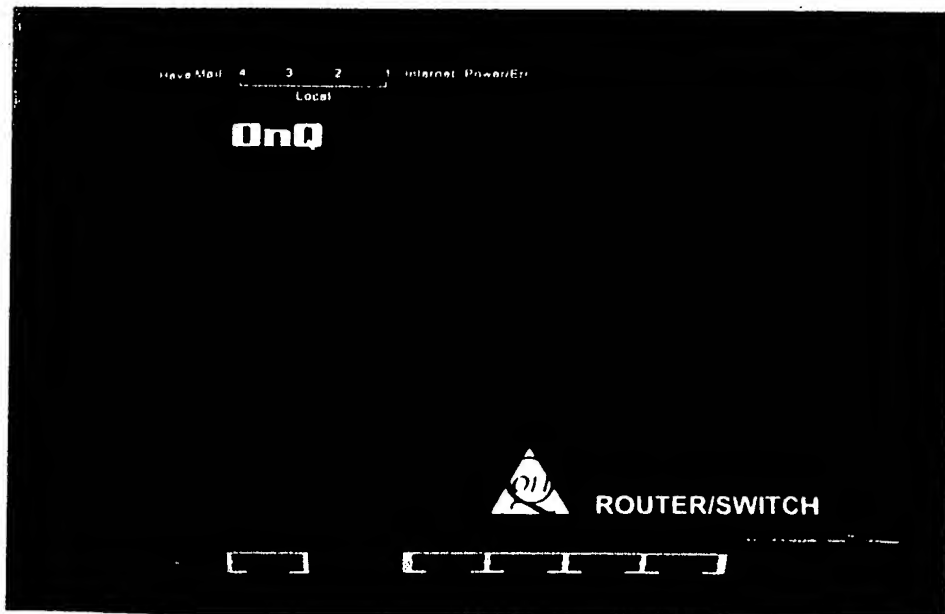
### Buyer Demographics

Who is purchasing structured wiring? According to builders, the most likely age group of homeowners are those between the ages of 35 and 44. Not surprisingly, that age group tends to be homeowners with higher incomes and who are not afraid to adopt new technologies. Younger homeowners between 25 to 34 are the next most likely to buy home electronics, followed by Baby Boomers between 45 and 54.

Conversely, very young homeowners (under age 24) and older persons (over 55) are the least likely to ask for home wiring.

Regarding income levels, wealthier homeowners with household incomes above \$200,000 are the target audience. Households earning under \$50,000 are longshot buyers.

Among builders themselves 78 percent report installing structured wiring in 2002 as either standard, an option or both. About 22 percent of builders report that they do not install infrastructure wiring. ■



Routers and switches can typically be installed as a module in the customer premise enclosure, or distribution box, to create a gateway or bridge to the Internet.



## Planning and Selling Multiroom Sound

Both Baby Boomers still in love with spinning vinyl and Gen Xers enamored with digital music files have soft spots in their hearts for multiroom audio systems.

Consequently, this hot technology is fast becoming a favorite among homebuilders. According to a National Association of Home Builders study, 8.6 percent of new homes in 2002 included multiroom audio compared to just 4 percent in 1996.

In years past, builders defined multiroom or distributed audio as a low-quality, static-filled intercom system for the front door that also just happened to include an AM/FM radio. Years later, many builders define distributed audio as a high-end, expensive audio system suited only for wealthy custom homes. Both definitions miss the mark when speaking about today's high-quality built-in audio systems that come in a variety of price ranges.

The concept is simple: Audio is transferred via wiring throughout the house from one or more source devices (CD

player/changer, turntable, MP3 player, tuner, DBS receiver, DVD player, or music storage/management system). Homeowners can access and control more than one source device, and play each one simultaneously in different rooms—without sacrificing the audio quality. The sound emanates from speakers (primarily in-wall or in-ceiling, but free-standing, bookshelf and on-wall speakers work just as well) strategically placed in every room in the house, even the kitchen and bathrooms, or outside on the patio.

Simple in theory, yes, but the task is not as simple as running speaker wire in the walls. In fact using the wrong cabling or technique can adversely effect the quality of the sound; thus, diminishing the overall experience of music in the home.

Whether it's a basic system playing background music, a high-end set-up, or something in between—builders should look to use a specialty low-voltage contractor. Distributed audio is a mainstay product line for most of the approximately 20,000 A/V installation companies in the U.S., thus creating a reliable installation channel upon which builders can rely.

### Audio for Everybody, Anywhere, Anytime

The reasons for the surge in popularity of distributed audio systems are simple. From the contractor/builder perspective, these systems are easy to have installed by the home electronics installer. Because the price of the technology has come down significantly, and can now be distributed over Cat 5e as well as 16/4 (audio wire), distributed audio has become a very attractive add-on for the homeowner. If these systems are built into the cost of the home, the add-on is as easy as upgrading from manual windows to power windows in your car, and is easily absorbed in the monthly mortgage payments. Multiroom audio is no longer for the rich and famous.

Even if a builder uses a professional installation contractor, he will be earning mark-up on the equipment and the labor. Most importantly, he will be providing customers with a built-in audio system that they will be satisfied with for years to come.

To help builders and consumers understand multiroom sound, the consumer electronics industry has created the Distributed Audio Alliance. Go to [www.multiroomaudio.org](http://www.multiroomaudio.org) for more information.

### Selling the Benefits

There are clear benefits to multiroom audio. Let's start with the obvious—the cool factor. With distributed audio, a homeowner can barbecue to classic rock on the patio while his wife cooks up her own music selections in the kitchen. Meanwhile their teenage son catches the ballgame in the family room, and their daughter blasts Britney Spears in her bedroom. And the best part is that each family member doesn't need his or her own stereo system—one system gives everyone access to all the music sources.

### BUILDER

- The concept of multiroom audio is simple: Sound is transferred via wiring throughout the house from one or more source devices.
- It is best to plan for a whole-house music distribution system during the pre-construction phase.
- With new developments in technology, the price of built-in audio has come down dramatically. Multiroom audio is no longer for the rich and famous.

### BASICS



The price of this family bliss used to be out of range for many. Within the past couple of years, new innovations such as audio hard drives—which store thousands of songs—MP3 players and CD-mega-changers have become viable music sources for a stereo system. When combined with receivers and amplifiers specifically designed to distribute audio—it creates an easy-to-operate system.

In addition to selling the benefits, as with all built-in technologies, homebuyers can roll the cost of the equipment

for a system to be placed inside their next home. What a deal!

### Plan Early and Create Zones

As with most hardwired home control systems that require cabling behind the walls, it is best to plan for a whole-house music distribution system during the pre-construction phase of your new home project or major remodel an existing home. These systems are much more suited for new home construction vs.

existing homes where the price tag for the wiring can be at least three times more than if cable installation is done while the walls of the home are exposed.

By the way, did we mention that a Cat 5 structured wiring infrastructure can support the transmission of audio throughout the home? So a builder installing a wiring network to handle phone

and Internet distribution has already created the backbone support for a distributed audio system. You may want to rely on your residential systems integrator to suggest the best wiring scenario to distribute audio based on what level of system will suit the budget and style of the new home.

How does a builder know how simple or elaborate a distributed audio sys-

tem should be? There are a series of questions to ask the homebuying prospect:

- How many locations (both indoor and out) do you want music “piped” to?
- How many people will listen to different music at the same time?
- Is it possible that the family would be happy listening to the same music at the same time?
- Will you listen to the music in the background while you are working around the house or will you be sitting down to specifically listen to the music?
- What kind of controls do you want in each room?
- What is your budget?

Each room or set of rooms can make up a listening “zone,” similar to heating and cooling zones of the house. For instance, one zone could be made up of the master bedroom, bathroom and hallway, while you might dedicate a room such as the kitchen to its own zone.

### Three Basic Levels of Systems

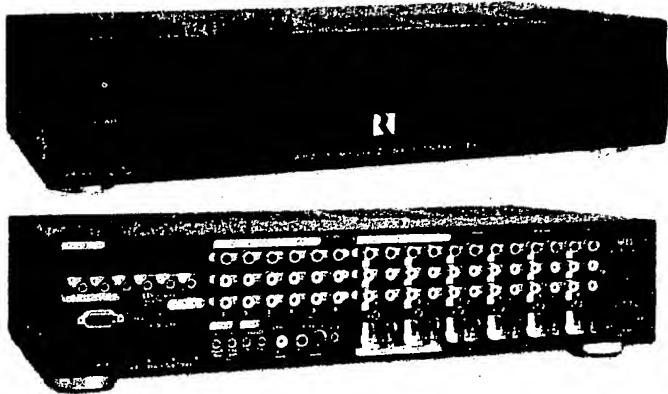
There are three basic levels of multi-room audio systems:

1: Simple: This set-up pipes music from one source to one zone consisting of two or three rooms. These systems typically include a basic receiver and use in-room volume controls and infrared (IR) repeaters for control.

2: Intermediate: This solution delivers a variety of music simultaneously to as many as six zones. Keypads and/or handheld remote controls are commonly used to cue and control the music. This type of system is called a multi-zone, multi-source music distribution system.

3: High-end: Basically, this solution offers the homeowner whatever he wants to listen to, wherever he wants to listen to it. The system might be using many of the same components from the intermediate solution, but this type of multi-source, multi-zone system can go high-end, where virtually an unlimited number of sources can be distributed to virtually an unlimited number of zones. In this premier system, sophisticated touch-panels are often used to control the music.

The price for a “simple solution” system can be sold to homeowners for about



Russound's CAV6.6 distributes six A/V sources to six zones, with inputs for paging and doorbell functions.

and installation into their mortgages. With distributed audio, many homeowners take the components with them when they sell the house (except the built-in speakers, volume controls and wiring, of course). So in essence, they have financed an audio system, paid only a portion of the total system cost each month in their mortgage and still end up with a many of the basic components



Niles Audio Corp's. new ZR-4630 multi-zone receiver is an example of a distributed audio system that can allow homeowners to listen to several music sources in different rooms throughout a home.





\$3,000 (equipment only, not including installation), or about \$500 per room. The simplest solution, which is not to be confused with an intercom, is a stereo receiver with two pairs of speaker outputs. Each output serves a separate room, or you can add a speaker selector box that includes volume control.

For retrofits, there are systems on the market that integrate with a home's existing phone network and include an audio amplifier with built-in multi-function intercom and IR repeater, a radio-frequency (RF) distribution amplifier and a telephone punch-down block, in addition to speakers and volume controls, of course.

A convenient addition to a starter system is an (IR) repeater. An IR repeater extends the reach of any existing handheld remote control, enabling users to set the music from almost any room of the house. Finally, the system needs in-wall or in-ceiling speakers, which can range from \$60 per pair to \$300 per pair.

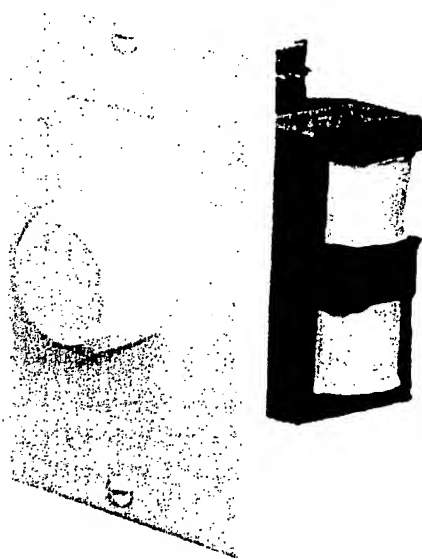
### Creating an Intermediate System

For about \$6,000 (end-user cost, again equipment only), or about \$750 per room, builders can offer homeowners a system that lets them access the family room CD player while working in the library, while the wife tunes to a DBS station from the kitchen. An intermediate-grade multizone, multisource audio system consisting of a preamplifier/receiver, keypad-style controls and IR repeaters serves anywhere from four to six zones. Upgrading to better speakers and/or adding weatherproof speakers outside in the yard are other options to consider.

Integral to this type of music distribution system is a multizone preamplifier/receiver. This component includes the switches, routers and amplifiers necessary to distribute multiple sources of music to several sets of speakers located throughout the house. Consider it the brains of the music system. The simplest type is a two-zone receiver that feeds music to two distinct listening areas. Some systems can shuttle four sources to four zones and are generally used for a home up to 2,500 square feet. More advanced multi-zone units can deliver



Intermediate audio distribution systems might also include in-wall controls, like the AKN-1 from Integra (above) and Channel Vision's ARIA (below).



six sources to six zones—a good size for a 3,000-square-foot home.

In addition to the zones they serve, multizone preamps also differ in the number of music sources they can support. A multizone preamp with four inputs, for example, can distribute music from four sources to a pair of speakers in each room.

A multichannel amplifier is another essential part of a music distribution system. It holds several independent amplifiers in one box. This attaches to the multizone preamp, and together, they sit inside the equipment cabinet with the rest of the stereo gear. Each of the inter-

nal amplifiers is dedicated to a listening zone. Amplifiers also differ in their power output. How loudly a homeowner likes to listen to music, the size of each zone and the distance from the preamp to the speakers all determine the best amplifier size to suit the home's needs.

This is also the system level at which a homeowner might want to add a more sophisticated control device, such as an in-wall keypad in each zone. From such a device, the user can select the type of music (DVD, CD, DSS station; radio station, etc.) as well as adjust the volume. Each music zone requires its own device to cue and control music sources remotely.

Speakers should be selected based on the homeowner's listening preferences and frequency of use. For example, the main listening areas such as the living room, den, kitchen, master bed/bath room, patio and other outdoor areas deserve high-quality speakers. Secondary listening areas like the laundry room and guest rooms might be well served by less expensive speakers.

### Creating a High-End System

Primarily for custom builders, a premier audio distribution system can be costly, but will carry the best multi-source/multi-zone controllers that can handle just about any number of music sources and any number of music zones.

System prices start at \$6,000 or about \$1,250 per room (since a homeowner can spend as much as \$25,000 on a pair of in-wall speakers, there is no limit to what can be spent). ■

### Distributed Audio Alliance

A-BUS	OnQ
Bose	Technologies
Channel Vision	Polk Audio
EH Publishing	Russound
Elan Homes	Sonance
Systems	SpeakerCraft
Niles Audio	Yamaha
Onkyo	

These 13 companies have forged a new alliance to promote the benefits of multi-room audio to consumers and builders.

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